

Concrete

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Gunite Bulkhead Walls in Florida

How Sea Wall Work Was Expedited By Using Interlocking Slabs Made By the Cement Gun Process and Jetted Into Place—How Slabs Were Made at the Yard

BY KENNERLEY BRYAN

The Riddle Company, Engineers, Palm Beach, Florida

The enormous development in progress in Florida during the past year, particularly at Boca Raton, on the East Coast, has called into being a new type of bulkhead wall to resist the encroachment of both the sea and inland waters upon established land lines, and for the purpose of forming new land by filling.

The prime requisites of such construction are that it must be resistant to the attacks of the teredo and limnoria, those destructive animalculae of tropical waters, that preclude the use of wood for piles or bulkheads above the mud line; and that it will resist the rapid deteriorating effect of sea water.

In developing the existing waterways in the new city of Boca Raton, Florida, and in the construction of new lakes and canals, Karl Riddle, chief engineer of the Mizner Corporation, hit upon an interesting solution of the problem of the construction of bulkheads.

This plan was first submitted to Addison Mizner in the very early stages of his development at Boca Raton, and he suggested several features which contributed largely toward the ideal wall.

He was especially impressed with the idea that copings and rails could be designed and constructed along the top of this wall, giving variety and harmonizing with other improvements along the wall.

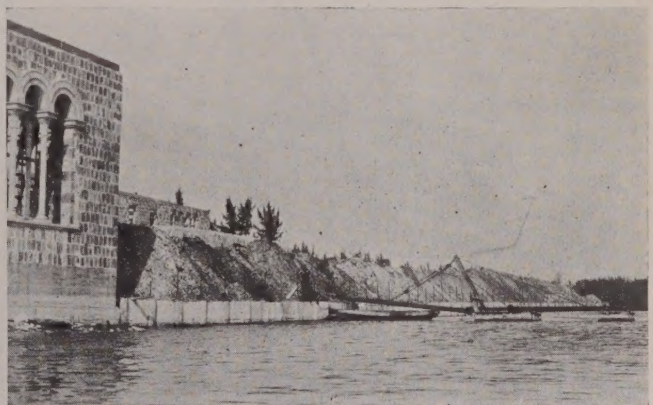
An example of his plan for such development is shown in the lower right hand photo on this page. It can be said, however, that while it was known that Mr. Mizner intended to use some type of coping, vertical rods for which were left, it was not thought the contractor would use such massive construction. The concrete coping and railing are solid in construction and with the fill, add a great deal to the wall, which was designed only to carry a flat coping.



This section of wall, viewed from the front, is completed and ready for the coping.



Here is the orange-peel dredge taking dirt out of the channel and dumping it behind the uncompleted wall. Notice the anchoring of the interlocking slabs—steel ties held by deadmen.



This might be called rushing the work. The wall is finished only up to the coping, but an excessive spoil bank has been thrown up behind it pending later distribution. The overload had no ill effect upon the wall.

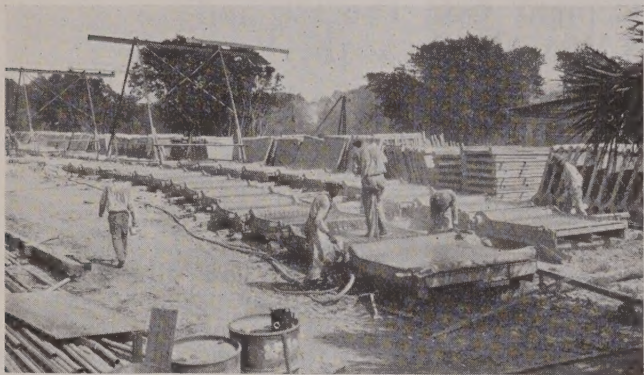
The Work a Success

Of course, arrangements could have been made to carry an additional load by driving wood piling behind the wall, but there does not seem to be any indication of failure since the wall has been constructed, having passed through a stage of disturbance during construction behind the wall, also extremely heavy rain and wind storms.

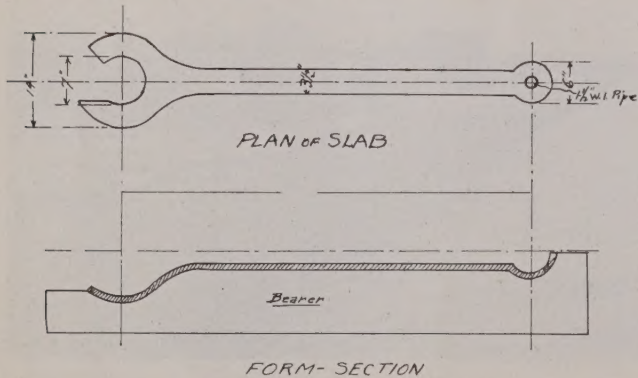
There are many miles of these bulkheads now building, and to be built, and a standard design, varying only in dimensions as required by local conditions, has been adopted.

In general, the design comprises a slab and pilaster construction, with a coping to give architectural finish, which coping is, in some instances, surmounted by an ornamental railing.

The selection of a material of which to build these bulk-



Here is a portion of one of the yards in which the slabs are manufactured. One stock pile can be seen in the background.



heads was a grave problem, owing to the scarcity of really good concrete aggregate, which would produce a concrete that would be impervious to water—thereby preventing the introduction of the destructive animalculae into the structure—and at the same time having the strength and durability required of such structures, at a cost which would be reasonable.

Gunite Selected

After a prolonged investigation Mr. Riddle decided to use "Gunite," being a material which would fulfill the requirements as to strength, durability, impermeability and cost; and, at the same time, a material which could be made from the aggregate available locally.

On page 16 is a typical illustration of the design of the bulkhead wall, from which it will be noted that, in principle, it is an interlocking slab founded on rock bottom, or on piles driven below the mud line, and having tie-backs secured to dead-men driven into the earth behind the wall.

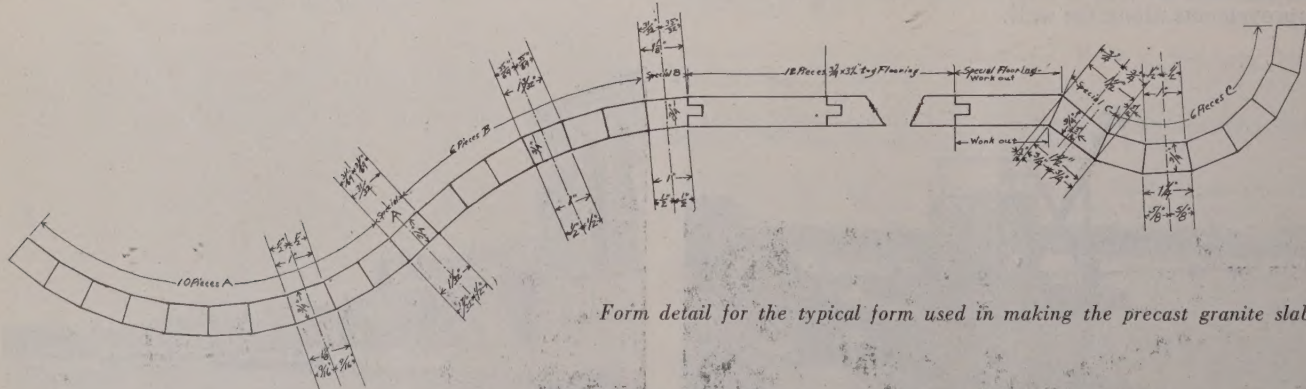
At each interlocking pilaster a galvanized steel rod is passed through a pipe incorporated in the key of the pilaster, and driven into the rock bottom or the head of the foundation pile, as the case may be, thus securing the bottom of the wall to a firm foundation.

By this means, also, the problem of design for strength is simplified in that the diaphragm between the pilasters becomes a slab with a span equal to the horizontal distance between pilasters. The distance between pilasters is determined by the distance required between pile supports for proper foundation.

Sheet Piling Not Needed

Another feature of this construction, which makes largely for economy, is that it is not necessary to sheet pile the water front to permit the erection of forms for the construction of a poured concrete wall. The slabs in the Riddle design are pre-shot with the cement gun on land adjacent to the site of the bulkhead, and transported to place and there set on the previously driven foundation piles.

It is to be noted that as the slabs are, for a given stretch of wall, all of the same size, and therefore the making of such slabs becomes practically a manufacturing proposition. A minimum number of forms is required, and, as the curing period for gunite in the Florida climate is only from 24 to 36 hours—at the expiration of which the slabs may be removed from the forms and stacked ready for placing—the time element is cut to a minimum.



Form detail for the typical form used in making the precast granite slabs.

QUANTITY FOR EACH FORM																	
Height of Slab	Height of Form	Pieces A		Special A		Pieces B		Special B		Pieces C		Special C		¾x3½ Flooring	Special Flooring		
		Number	Length	Number	Length	Number	Length	Number	Length	Number	Length	Number	Length		Number	Length	
4'-0"	5'-0"	10	5'-0"	1	5'-0"	6	5'-0"	1	5'-0"	6	5'-0"	1	5'-0"	12	5'-0"	1	5'-0"
6'-0"	7'-0"	10	7'-0"	1	7'-0"	6	7'-0"	1	7'-0"	6	7'-0"	1	7'-0"	12	7'-0"	1	7'-0"
7'-0"	8'-0"	10	8'-0"	1	8'-0"	6	8'-0"	1	8'-0"	6	8'-0"	1	8'-0"	12	8'-0"	1	8'-0"

NOTE:—
Form for 4' slab to have 2 end bearers, and 1 intermediate.
Form for 6' slab to have 2 end bearers, and 2 intermediates.
Form for 7' slab to have 2 end bearers, and 2 intermediates.

In fact it has been demonstrated that the slabs can be made and cured faster than they can be set in place.

The Slab Described

As shown on the opposite page, a typical form for these slabs consists essentially of bearers formed to make the lock at one end and the key at the other to form the interlock. The core of the lock is made by the use of a collapsible wooden mandrel supported at each end outside of the slab form, also the pipe in the key end is set in place in the form and the Guniting shot around it. The flat surface of the form is made with tongued and grooved strips and the lower exterior curve of the lock is made with battens. The slabs are shot with the form in horizontal position. The upper curve of the lock, and key, are made with a formed screed.

The reinforcement of the slabs is generally a heavy square welded wire mesh of size to give the proper area of reinforcement. This mesh is placed upon the form after being shaped to fit the lock and key and is shot in the Guniting.

It is sometimes necessary, in the case of heavy stresses in the wall, to use reinforcing rods for the main reinforcement, but in these cases it is always advisable to use, as well, a square mesh in addition to the rods, to take care of temperature stresses.

Setting is Easy

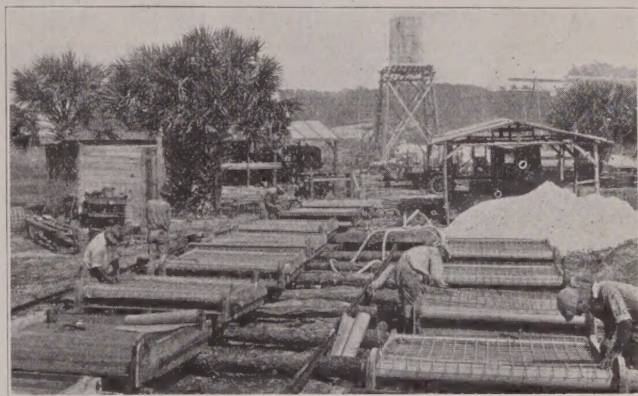
The process of setting these slabs is a very simple one. Where it is necessary to use piles for foundations, these are driven by water or land plant at the proper intervals to receive the rods of the pilasters. The proper elevation of the tops of the piles is generally obtained by driving with a follower, thus saving cutting off. The elevation of the head of the piles is fixed below the scour influence.

The slabs are then taken from the stock piles and erected, generally by jetting into place, the use of a hammer not having been found necessary. The small annular space around the key in the lock quickly fills with sand and becomes tight. This clearance space is shown to be one-half inch, but in practice it works out less.

The specifications for the Guniting call for one part Portland cement to three parts clean sharp sand. The size of reinforcing mesh varies with the load and span of slab. The sand is screened through a three-eighth inch square screen, which gives an aggregate thoroughly filling the requirements.

Test Data

Below is shown the results of tests made for compression to show the comparison between the fine sand prevalent in Florida, and a very excellent grade of bank or bar sand which is used considerably in Miami, being imported from the West Coast. The tests were made in July, 1925, at Lehigh University. The samples were 2 in. square and 8 in. long, and Professor M. O. Fuller of Lehigh University decided that it would be inadvisable to make compression tests on the 2x2-in. ends, as a column effect would be introduced which would be detrimental. This, therefore, accounts for the tests being made on the 2x8-in. dimensions.



Another view of the yard where the slabs are made, with the sheds that house the cement gun equipment. A number of forms are being made ready for use and the reinforcing is being put into place



A workman is here shooting one slab, another is finished and is covered with wet burlap, while a third slab is ready for its guniting. Completed slabs are piled in the rear, waiting transportation to the water front.



The derrick boat is setting an interlocking slab into position, and will lower and jet into place.

The following will be very interesting as showing the very excellent results in direct compression. Note that with the high grade of bank or bar sand the average was 7600, and for the fine Florida sand the average 7260. These samples were less than 60 days old when tested.

COMPRESSION TESTS

STANDARD LAKE WEIR SAND				
Mark	Dimensions	Area	Loads, lbs.	Lbs./sq. in.
5-15	2"x8"	16 sq. in.	123150	7690
5-15	2"x8"	16 sq. in.	117200	7320
5-15	2"x8"	16 sq. in.	136800	8550
5-21	2"x8 1/4"	16.5 sq. in.	117800	7140
5-21	2"x8 1/4"	16.5 sq. in.	126800	7680
6-15	2"x8 1/4"	16.5 sq. in.	125750	7620
6-15	2"x8 1/4"	16.5 sq. in.	116000	7030
6-16	2"x8"	16 sq. in.	123000	7690

FINE FLORIDA SAND				
Mark	Dimensions	Area	Loads, lbs.	Lbs./sq. in.
1	2"x8"	16 sq. in.	106600	6660
2	2"x8"	16 sq. in.	112400	7020
3	2"x8"	16 sq. in.	104000	6500
4	2"x8"	16 sq. in.	118000	7370
5	2"x8"	16 in. sq.	122500	7660
6	2"x8"	16 sq. in.	115400	7210
7	2"x8"	16 sq. in.	108000	6750
8	2"x8"	16 sq. in.	119750	7480
9	2"x8"	16 sq. in.	144150	9010
10	2"x8"	16 sq. in.	114500	7150
11	2"x8"	16 sq. in.	110500	6900

On page 13 is a very interesting example of the liberties taken with structures during construction periods. The photograph shows a section of wall completed up to the coping behind which a dredge has piled up a spoil-bank for later distribution over a fill. The top of the wall is about three feet above the water and the crest of the bank is about ten feet above the water. The wall was designed and built to sustain a fill which would surcharge the wall two feet. This photograph was taken about three weeks after the spoil bank was thrown up, and this bank remained as shown for about two weeks longer. The additional weight imposed upon the wall structure had no

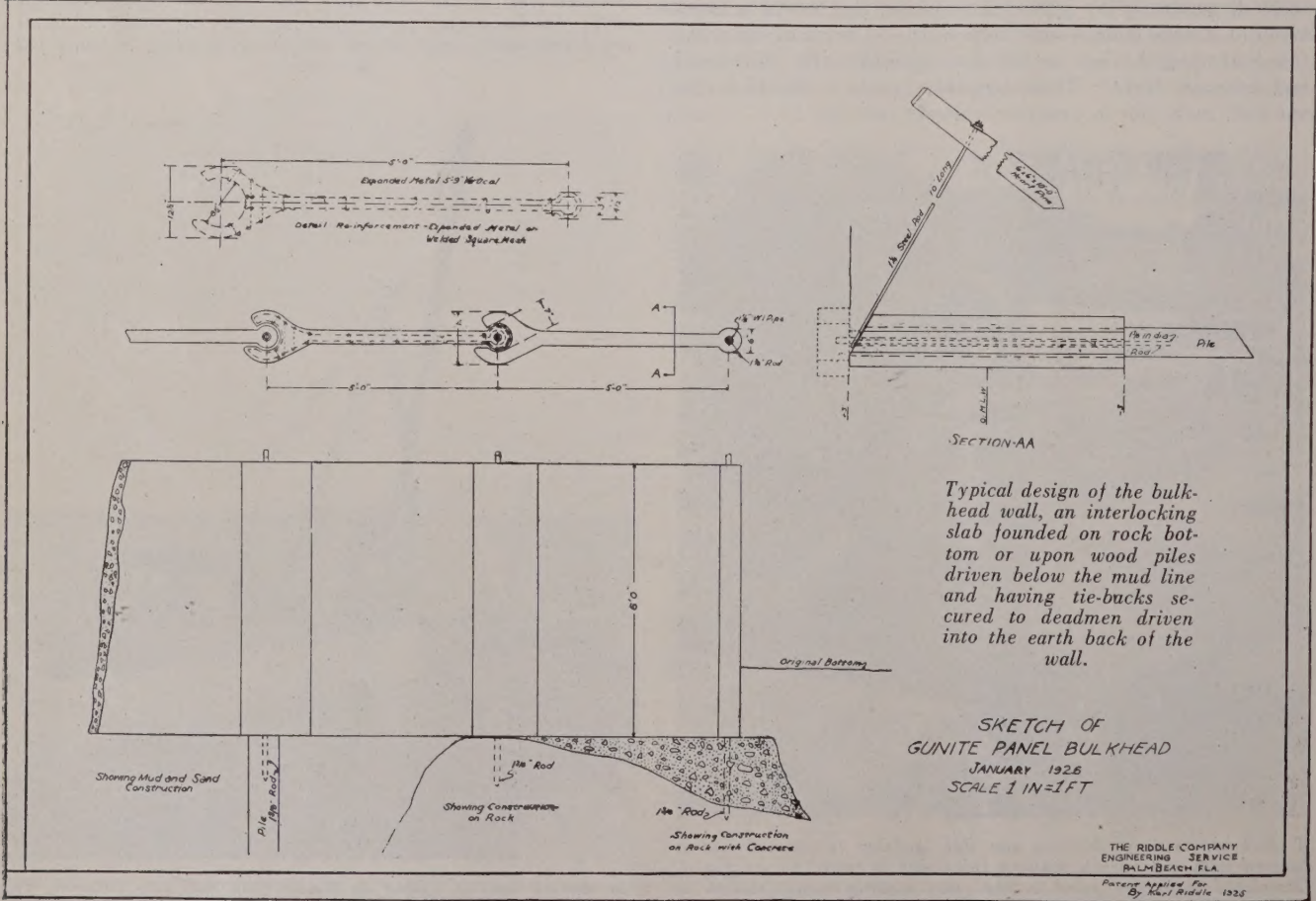


Driving the foundation piles just ahead of the work of setting the gunite slabs.

effect upon it, it remained in line as originally set, and showed no evidence of undue strain.

Cost Records of Interest

- Careful costs have been kept on the work at Boca Raton, and work out as follows:
- Wall, 6'-0" high (slab height).
 - Span of each slab, 5'-0", distance between interlocks.
 - Thickness of slab, 3 1/2".
 - Reinforcing mesh, 4"x4".
 - Foundation piles 12", spaced 5'-0" centre to centre.



Costs are given per lineal foot of wall:

Piles	\$0.75	
Handling and driving piles	1.75	
Dead-man, driving, and tie-back in place	3.06	
Total cost foundation and tieback		\$5.56
Cement, sand, mesh, pipe in key	\$6.56	
All labor manufacturing comprising: Foreman, repairs to plant, handling Gunite materials, repairs to forms, placing mesh in forms, shooting slabs, finishing, storing and cleaning	\$3.44	
Total cost of manufacture		\$10.00
Average cost handling slabs from yard to place	\$0.75	
Setting on foundation	3.43	
Total cost setting		\$4.18
Forming plain coping in place	\$0.65	
Materials for coping	.15	
Shooting coping in place	.50	
Stripping coping	.05	
Finishing coping	.08	
Total cost coping in place		\$1.43
Plant charge		.36
Total cost of wall in place per lineal foot		\$21.53

Construction Plant Used

The plant required for the particular wall from which the data given are taken, and which is illustrated by the photographs, comprises:

- Two 14x12 air compressors.
- Two N2 cement guns.
- Two hoisting cranes.
- 1200 ft. 30 lb. rails.
- Pumps sufficient for 50 gal. per min. for hydration and curing.
- Water tanks.
- Two hoisting engines.
- One pile driver.
- One derrick boat.

The average production of slabs in the yard has been 28 per day. The number of slabs set in place has averaged 10 per day.

The wall described has a total length of 8800 ft. divided into slabs 6 ft. 0 in. high by 5 ft. 9 in. span between pilasters. There were 150 sets of forms made for manufacturing these slabs at the initial cost of about \$30 each.

The success of this type of wall—known as the “Riddle Bulkhead Wall”—has been so great that it has been adopted by the city of West Palm Beach, the city of Lake Worth, the city of Boynton and the city of Boca Raton, as well as by the owners of many large properties requiring such work. Patents have been applied for by Mr. Riddle for this type of construction. The work described and shown in this article is being executed by A. Petrinovich of Jacksonville, who is the contractor for piling and setting of the slabs, and the Cement Gun Co. of Allentown, Pa., which is the contractor for the manufacture of the slabs.

French Government Studies Concrete Highways

By THEODORE WOLFRAM

Considering the high reputation that the roads and highways of France have held for ages it is quite a shock to the foreign tourist to discover the disgraceful state into which practically all routes and particularly the famous *Routes Nationales* have degenerated.

These routes seem to be continually undergoing repairs but with very few exceptions nothing seems to be undertaken that can be considered permanent. Even the best known and most important *Route Nationale*, Number 7, which links Paris with the Riviera and Italy is simply being resurfaced with a mixture of crushed stone and mud

which makes an excellent surface during a few short weeks and then goes all to pieces under the heavy traffic.

According to the French commercial journal, “*La Journée Industrielle*,” the French government department of “Bridges and Roads” has finally undertaken a serious study of concrete as a road-building material and recently sent one of its engineers, M. A. Antoine, to America to make a thorough study of American roads and road-building methods.

Mr. Antoine’s report would indicate that he had really given his subject conscientious consideration and after his formidable array of statistics and figures have been digested the outstanding facts seem to be that he has returned to France full of admiration for American roads and methods and an enthusiastic proponent of the concrete roadways.

While he found that in America a concrete road requires a foundation of approximately 25 centimetres he believes that the century old routes of France could be concreted on a foundation of only 10 to 15 centimetres. In spite of this saving the cost would still be from 20 to 50 francs per square metre or 180,000 to 300,000 francs per kilometre on a roadway 6 or 7 metres in width. What he particularly emphasizes is the permanency of properly constructed concrete roads and the extremely low cost of their upkeep.

Water Glass Does Not Raise Strength of Concrete*

The success of the so-called high-strength portland cements in Germany has led to various attempts to achieve the same results by the use of various admixtures in ordinary portland cement. Among these there appeared a widely advertised compound “*Securit*,” which, when used in the mixing water in quantities from 5 to 10%, was supposed to impart to the concrete all the advantages of high-strength cement concrete, such as high initial and final strength and impermeability. The chemical analysis made at the Laboratory of the Association of German Portland Cement Manufacturers revealed water glass as its main constituent. Tests of time of setting and strength did not show the advantages claimed.

In this connection the Laboratory published some previously collected data on water glass admixtures. An ordinary portland cement was used in the investigation. Water glass was added to the mixing water in quantities of $\frac{1}{4}$, $\frac{1}{2}$ and 2%.

The following conclusions were drawn:

1. The time of setting is not affected appreciably by $\frac{1}{4}$ to $\frac{1}{2}$ % water glass; it is accelerated by higher percentages (2%).

2. The compressive strength is considerably reduced in all cases. A 2% admixture reduces the strength at 2 days to 80%; at 7 days to 76 and at 28 days to 66.

3. The tensile strength is not appreciably affected by the mixture of water glass.

4. Contrary to the information commonly encountered in laboratory handbooks, water glass used as an admixture in the mixing water is detrimental to the strength of concrete.

5. This does not apply to water glass when used as a surface coating to increase the hardness of concrete, a process which appears to have given good results on concrete roads in England. The alkali liberated during the application of the surface coating is made harmless by the carbon dioxide of the air, while in the concrete it forms compounds which impair the strength.

*Abstracted from an article by Dr. G. Haegerman, in *Zement*, October 1, 1925, Margaret Arronet, Chicago, Ill.

Tests on Casein as an Admixture

Limited Quantities of Casein, When Used As An Admixture, Found to Increase Workability, Hasten Setting and Decrease Tensile Strength of Concrete

By W. E. HASKELL

Chemist, Hollister, California

Admixtures of cement and other compounds, while not new, have recently come into a much more widespread usage, and a number of compounds are now on the market, the use of which is recommended to increase the plasticity or workability of concrete mixtures, to render the concrete waterproof, and to increase the bulk. Some cement manufacturers add the compound at their mills and sell the resulting product under a special brand or trade name. Some of the compounds whose use has already been tried are calcium oxy-chloride, hydrated lime, diatomaceous earth, and stearates or other fatty compounds.

As casein has been widely used in plastics, glues, paints, etc., and forms lime compounds, and is also easily obtainable at a reasonable price, a series of preliminary experiments was undertaken to test its availability as an admixture with portland cement. It was noticed that even a small percentage produced a noticeable fluidity in the mixture of neat cement and casein.

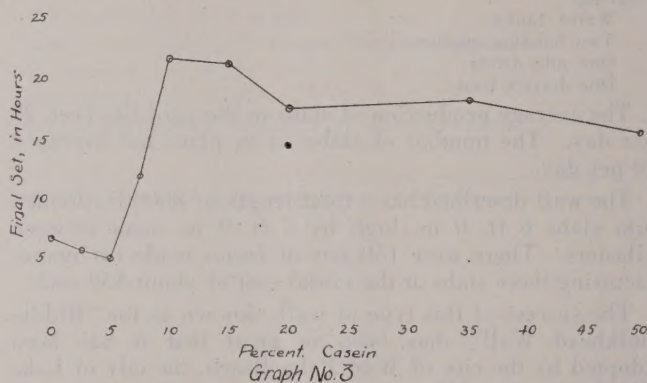
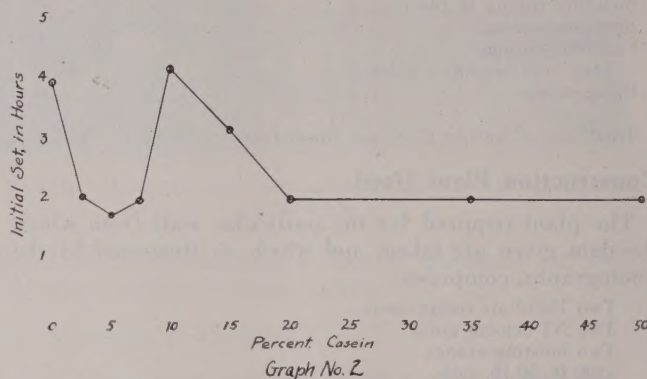
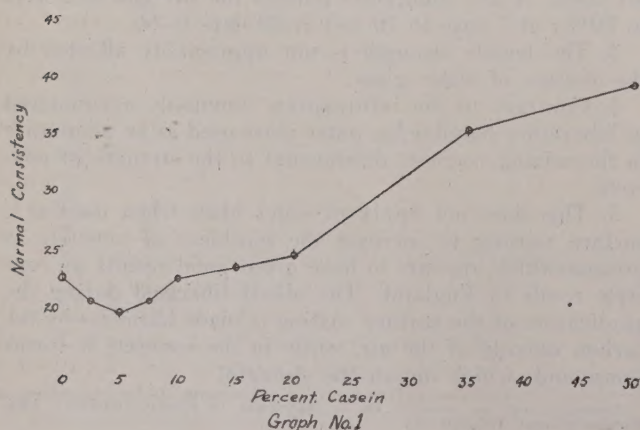
The casein used in the experiments was a powdered commercial brand and the cement a standard brand of normal portland.

Mixtures of different proportions of the materials were made up as follows, and in the text following and the tables and graphs are given the numbers assigned below.

1. Neat cement.
2. 97½% cement, 2½% casein.
3. 95 % cement, 5 % casein.
4. 92½% cement, 7½% casein.
5. 90 % cement, 10 % casein.
6. 85 % cement, 15 % casein.
7. 80 % cement, 20 % casein.
8. 65 % cement, 35 % casein.
9. 50 % cement, 50 % casein.

The determinations were conducted in the manner prescribed by standard specifications except as hereinafter noted and were as follows:

Normal consistency.
Initial set.
Final set.
Consistency of volume.
24-hour neat tensile strength.
Elongation.



Variations from standard procedure were as follows: The normal consistency was determined by means of the Vicat needle in the usual manner until mixture No. 6 was reached. At this point the sticky, rubbery character of the mixture precluded the use of the Vicat needle and normal consistency was considered to be the point at which the mixture attained workable consistency.

The Gilmore needle was used in determination of the setting times, but due to the rubbery character of mixtures Nos. 6, 7, 8, 9, setting time was considered to have been reached when the indentation made by the needle disappeared in less than 15 seconds.

Normal Consistency

The smaller amounts of casein reduce the amount of water required for normal consistency until mixture No. 4 is reached when the amount necessary increases, until at No. 9 the water required is nearly double that of No. 1. (Graph No. 1.)

The troweling of the test pieces in the case of Nos. 2 and 3 caused the casein and water to be floated to the surface, producing an almost fluid condition, mixtures Nos. 4 and 5 remained homogeneous, and Nos. 6 to 9 were of a sticky, rubbery character as before noted.

Setting Time

Notwithstanding the fluid surface conditions of mixtures Nos. 2 and 3, the setting times on these mixtures were appreciably shortened as were also those of mixtures Nos. 4, 6, 7, 8, 9 (Graph No. 2).

The final sets on mixtures Nos. 2 and 3 were shorter than that of the neat cement, all other mixtures much longer. (Graph No. 3.)

Constancy of Volume

Mixtures Nos. 1, 2, 3, 4 all passed the steam test satisfactorily, the other mixtures were all unsound.

Tensile Strength

The tensile strength of the mixtures was determined at

the expiration of 24 hours except in the case of mixtures Nos. 4 and 5. In attempting to remove the briquettes from the molds, Nos. 4 and 5 repeatedly cracked longitudinally and the attempt to make tests on these mixtures was abandoned.

The tensile strengths show a decided loss as the percentage of casein increases, and the mixtures of rubbery consistency show an appreciable elongation before breaking.

After standing in air a few hours the pieces lose their rubbery character and become soft and crumbly, as they dry out.

The following tabulation illustrates in condensed form the results of the experiments:

	MIXTURES								
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
Normal consistency	23%	21%	20%	21%	23%	24%	25%	36%	40%
Initial set	4H. 0M.	2H. 5M.	1H. 45M.	2H. 0M.	4H. 10M.	3H. 10M.	2H. 0M.	2H. 0M.	2H. 0M.
Final set	7H. 0M.	6H. 0M.	5H. 15M.	12H. 30M.	22H. 0M.	21H. 45M.	18H. 0M.	18H. 30M.	16H. 0M.
Constancy of volume	O. K.	O. K.	O. K.	O. K.	Unsound	Unsound	Unsound	Unsound	Unsound
Tensile strength—24 hours	395 lbs.	310 lbs.	150 lbs.	—	—	25 lbs.	10 lbs.	5 lbs.	5 lbs.
Elongation millimeters	—	—	—	—	—	4	5	6	10

Casting a Massive Foundation Mat

How a Western Engineer and Contractor Put in a Secure Foundation for a Public Building—The Reinforcing Used—Concrete Controlled by Inundation

By MICHAEL J. PHILLIPS

Some interesting problems, and the evolution of methods equally as interesting to solve them, have been the outgrowth of the Civic Center project at Pasadena, California. The successful casting of the great monolithic concrete mat which will support the tower of the City Hall, a unit of the Civic Center, is well worthy of description. The mat, so far as known, is the largest on the Pacific Coast.

The City Hall dimensions are 232 by 351 feet. The height is 228 feet from the footings to the top of the tower. The main portion of the structure is three stories and basement. The construction is Class A, reinforced concrete, with a tower of structural steel. The reinforced concrete mat to support the tower is irregular in shape, 100 by 104 feet at its longest and widest dimensions, and five feet thick.

Reinforcing in the mat consists of 160 tons of 1 1/4 inch square deformed bars, placed in two layers in the concrete. These layers are respectively six inches from the top, and six inches from the bottom of the mat. Each layer consists of a grill of 1 1/4 inch bars laid at right angles to each other. The bottom reinforcing bars were spaced 12 3/4 inches by 7 1/2 inches on centers; the top, 4 1/2 inches by 7 1/2 inches on centers.

After the ground had been cleared and leveled, parallel concrete sills were constructed on the site of the mat. The sills, 6 inches wide by 4 3/4 inches high, were built to the grade of the under side of the lower layer of steel. There are nine sills, spaced from 11 feet, 3 inches to 14 feet, according to the shape of the mat.

The sills were built to insure a perfect placing of the steel at a proper height from the bottom of the mat. This is different from the ordinary practice, which consists in putting loose pieces of concrete at random beneath the steel. The sills provide a proper elevation for the steel.

After placing the lower steel, the next step was the erection of steel chairs, brought up from the sills to carry the upper layer of steel. The chairs guaranteed accurate vertical spacing and adequate support for the steel.

Lubricant Used

The concrete mix for the mat was as follows: One part of cement; 1.85 of sand; 1.84 of gravel, 3/4 inch to 1/4 inch; 2.31 of 2-inch crushed rock; one per cent by weight of Featherstone (diatomaceous earth). This totaled a mix of one to six. The proportions of all aggregates were determined by sieve analyses, maintaining the maximum density of concrete and the minimum amount of water. Sand was measured by a Blaw-Knox inundator, diameter 22 1/2 inches. The device is cylindrical, about 3 feet deep; the volume of sand is regulated by a movable diaphragm.

The amount of water required to inundate the sand is determined by the percentage of voids in the sand, which in this case was 33.8 per cent. The mixer being of 4-sack capacity, 7.4 cubic feet of sand were required per batch.

The amount of water, then, necessary to inundate the sand was 33.8 per cent of 7.4 cubic feet, which is 21 cubic feet, or 18.75 gallons. As the mix required 20 gallons of water for the batch, this left 1 1/4 gallons to be supplied by an auxiliary tank.

Water for the inundation was first poured into the barrel of the inundator, and the sand sifted into it. This gives practically the same volume as dry sand. If the sand is delivered wet, there will be an overflow of excess water; if dry, the entire amount of water will be used, thus giving a constant quantity of sand and water.

The gravel and rock used were measured in separate adjustable batchers, the sand being maintained in a constant volume, and any difference or fluctuation of materials was adjusted in proportions of gravel and crushed rock.

Getting Workability

For instance, if there was too much rock for workability, the amount of rock was reduced and the gravel was increased. An automatic timer on the mixer insured a minimum mixing time of one minute after all materials were in the drum.

About 50 test cylinders, 6 by 12 inches, were made during the pouring of the mat and broken by three agencies—Prof. F. J. Converse of the California Institute of Technology; the Riverside Portland Cement Company, of Riverside, California; and by the Raymond G. Osborne Laboratories of Los Angeles.

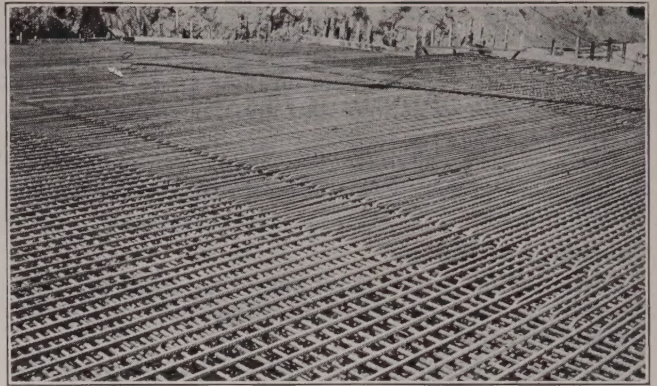
These cylinders showed an average strength of 1332 pounds per square inch for the 7-day period. The minimum was 1032 pounds.

The specifications required a strength of 1000 pounds in 7 days, with a minimum of 900 pounds, with the understanding that the latter strength, if it existed, was to be temporarily rejected until the 28-day strength was obtainable. If, at the end of that time the 900-pound concrete came up to the required strength of 2000 pounds, it would be accepted. However, the 7-day test was well above the minimum mark. The average strength for the 28-day period was 2260 pounds, with a minimum of 1852 pounds. The consistency of the concrete gave a slump of $3\frac{1}{2}$ to 4 inches. In pouring, the slope of the chute from the construction tower was 35 per cent. The chute was supported by a highline.

Concrete Chuted

The entire area of the mat was covered by an adjustable chute. Pouring was continuous night and day to prevent formation of construction joints. The pour was so arranged that all concrete was deposited on a fresh surface, successfully eliminating all joints. Eighty-four hours were required to complete the mat. The crew, in 8-hour relays, consisted of 2 men in the cement house, 2 on the mixer platform, and 8 on the mat, handling the chute and tamping.

Architects for the Civic Center Project are Bakewell & Brown of San Francisco. The contractor is Orndorff Construction Company of Los Angeles. A. P. Ames was the superintendent. Full co-operation on the mat pouring job



The top grillage bars in place and ready for the concrete. This massive mat will support the tower of the new city hall in Pasadena

was secured from Walter Putnam, chief inspector, Pasadena Building Department, and his deputy, Walter Zurtell, who were on the job night and day.

The use of excess sand and water in mixing concrete is a common practice. The reasons for the extraordinary care and precautions taken on the mat, in the measurement of materials and testing of concrete, was to demonstrate that good concrete can be made without excess sand and water. The benefits derived from the experiment are being shown by the eagerness with which the new practice is being adopted on buildings since inaugurated in Pasadena and vicinity.

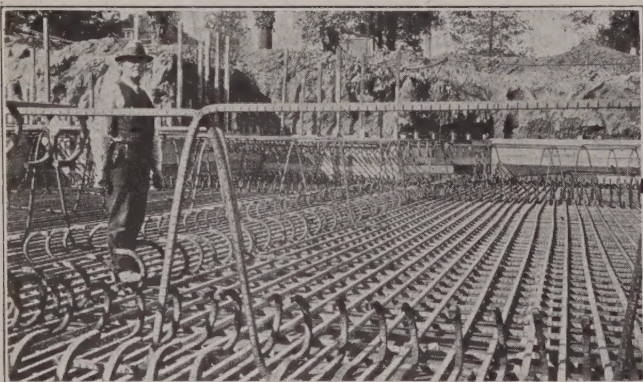
Harvey W. Hincks, a member of the American Society of Civil Engineers, is engineer in charge of the Civic Center project. He superintended the preparation of the mix and the pouring of the mat, and the perfect result is a tribute to his forethought, knowledge and ability.

Mixer Standards Work Advancing Toward Completion

According to recent information from the secretary of that organization, the Mixer Manufacturers Bureau of the Associated General Contractors of America has held several meetings this year, at which some progress has been made toward further and more complete standardization of the design and production of concrete mixers. This Bureau, made up of thirteen manufacturers of concrete mixers, is now discussing the advisability of adopting a 10-E paver in place of the standard size now known as the 7-E, and discontinuing the production of the latter size. The question may be finally settled during a meeting to be held during the first week in June.

The backers of the proposed size claim that the smaller mixer is primarily intended for use in laying sidewalks, and of curbs and gutters, and that since the usual specification for this work calls for 1:2:4 concrete, and since the 7-E machine is too small for a two-bag batch and too large for a one-bag batch of that proportion, that the contractor would find a 10 cubic foot mixer more to his advantage. The 7-E machine was originally designed for a one-bag batch of 1:3:5 or 1:3:6 concrete, while the 10-E would be designed for a two-bag batch of 1:2:4 mix.

Another work undertaken this spring has been the formulation of a set of by-laws to govern the work of the Bureau. They set forth the aims of the Bureau, and give a set of rules and regulations for matters such as administration, membership, elections, meetings, financing, modifications of standards, etc. Mr. Harold E. Smith, president of the T. L. Smith Company, has been elected chairman of the Bureau to succeed Mr. Geo. C. Ellis of the Ransome Concrete Machinery Company.



Bottom grillage of reinforcing bars, showing some of the steel chairs to support the upper grillage in place

A Profitable Central Mixing Plant

How a Texas Contractor Has Installed a Plant Where Concrete Is Mixed Before Delivery to the Job—The Equipment Used—The Staff Required for Plant Operation—Handling Bulk Cement—Paving Methods of the Concern—Delivering Dry Proportioned Batches—Special Truck Body to Handle Mixed Concrete

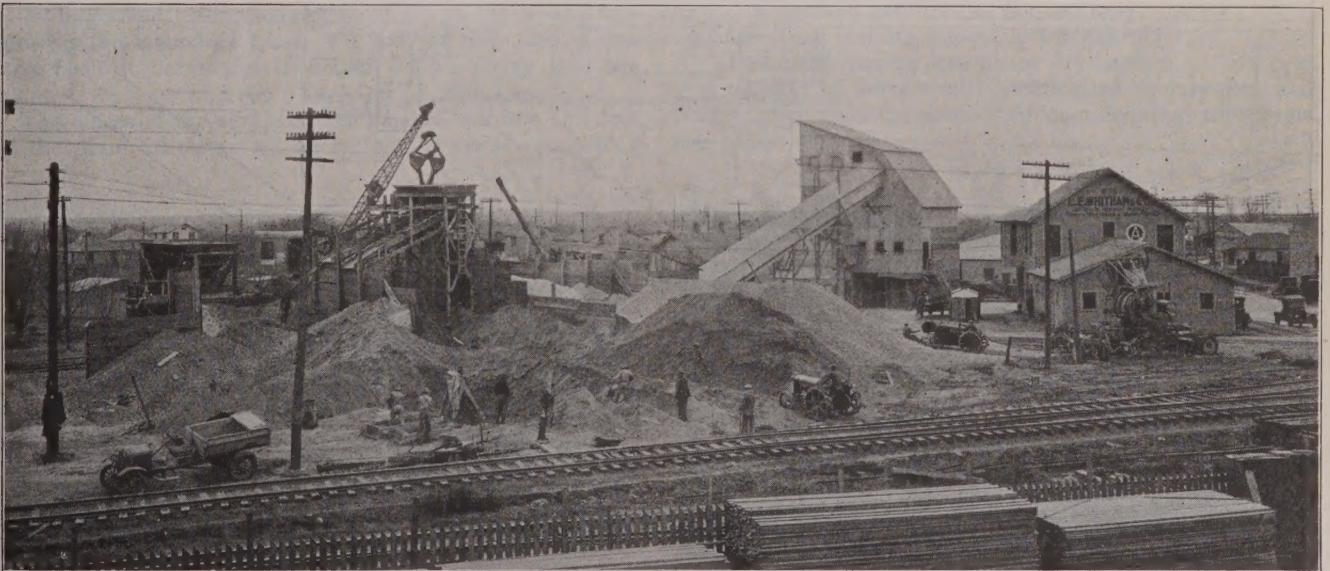
By H. A. SAWYER

Associate Member, American Society of Civil Engineers

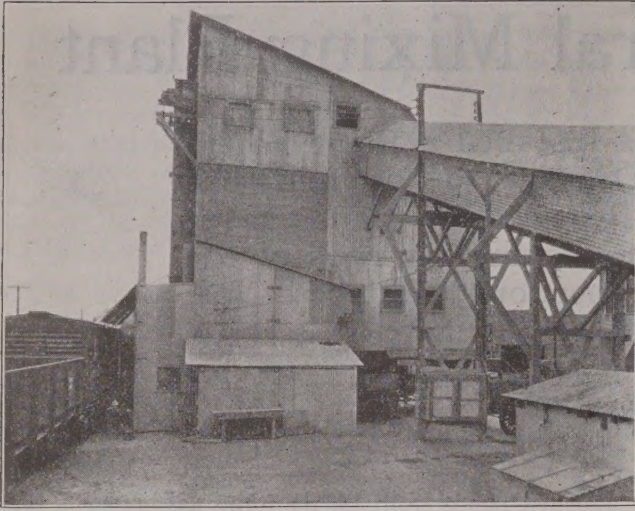
There has developed, during the past few years, such a widespread interest in the use of central mixing plants, and in the sale of ready-mixed concrete, that CONCRETE is constantly and frequently called upon for information on the feasibility of the idea, and on the plant equipment and staff required to carry on such work. Acting upon the belief that valuable ideas might be found at the plant described below, Mr. Sawyer, an experienced engineer, was prevailed upon to visit the plant and make a report upon what he could find there. Although the bulk of the concrete mixed in this plant is used on paving work, there is no reason why the larger building contractor could not as well install such a plant, and perhaps sell his surplus production to others, especially to the builder of small homes, who is engaged in placing many foundations here and there about town. Then, too, there is an opportunity here for the block manufacturer and for the material dealer.—The Editors.

Concrete that is ready for the forms has become a commodity that is being used in a number of places in the United States, and the success of the practice by responsible contractors will undoubtedly extend the field of this practically new method of placing concrete. The very nature of the material requires that it be delivered to the job before it has had a chance to set. It must reach the job in a thoroughly mixed condition and separation of the constituents must be avoided. The specifications of the city of Wichita Falls, Texas, are very rigid, requiring that the concrete be of a consistency that will permit economical use and give maximum strength. On paving work the quaky mix gives almost maximum strength.

The L. E. Whitham & Company organization readily saw the adaptability of stiff mixtures for city and county concrete pavements and in the face of very adverse conditions started promoting reinforced concrete for Wichita Falls streets, with the idea of using a ready-mixed commodity. The fact that this company has been awarded contracts for concrete alleys, streets and roads in and around Wichita Falls totaling approximately 700,000 square yards from 1919 to the end of 1925, should convince the most skeptical that "The City that Faith Built" has faith in concrete for its streets and roads. The quality of construction will rank with the best in the country. A total of 150,000 square yards went on the highways, while some 550,000 square yards were awarded for the improve-



General view of L. E. Whitham & Co.'s plant, with every department in full operation. Notice the yard equipment for handling the aggregates



Close-up of the enclosed plant. Bins in the top of the plant receive materials from inclined conveyors. Note the car of bulk cement on the left being unloaded and elevated by a bucket conveyor. Hinged doors enclose the opening in the car to prevent loss of cement

ment of streets and alleys. All of the latter yardage and a good portion of the former were mixed at a central plant and delivered by trucks to the various projects. Some idea of the gradual successful development of the central mixing plant idea can be gained from the fact that this company steadily increased its contracts each year from 31,000 square yards of pavement in 1919 to the large total of 330,000 square yards in 1925.

Operation of the Plant

The central mixing plant is built along a concrete-paved street, which makes it easily accessible to trucks. Cars of materials reach the plant over the company's 850-foot private track, which permits the placing of ten cars at a time. Switching is done by either the F. W. & D. C. Railway or the W. F. & S. Railway, who have joint rights to the track.

The materials are unloaded by an Austin No. 3 Simplex crane, with a Byers auto crane acting as an auxiliary.

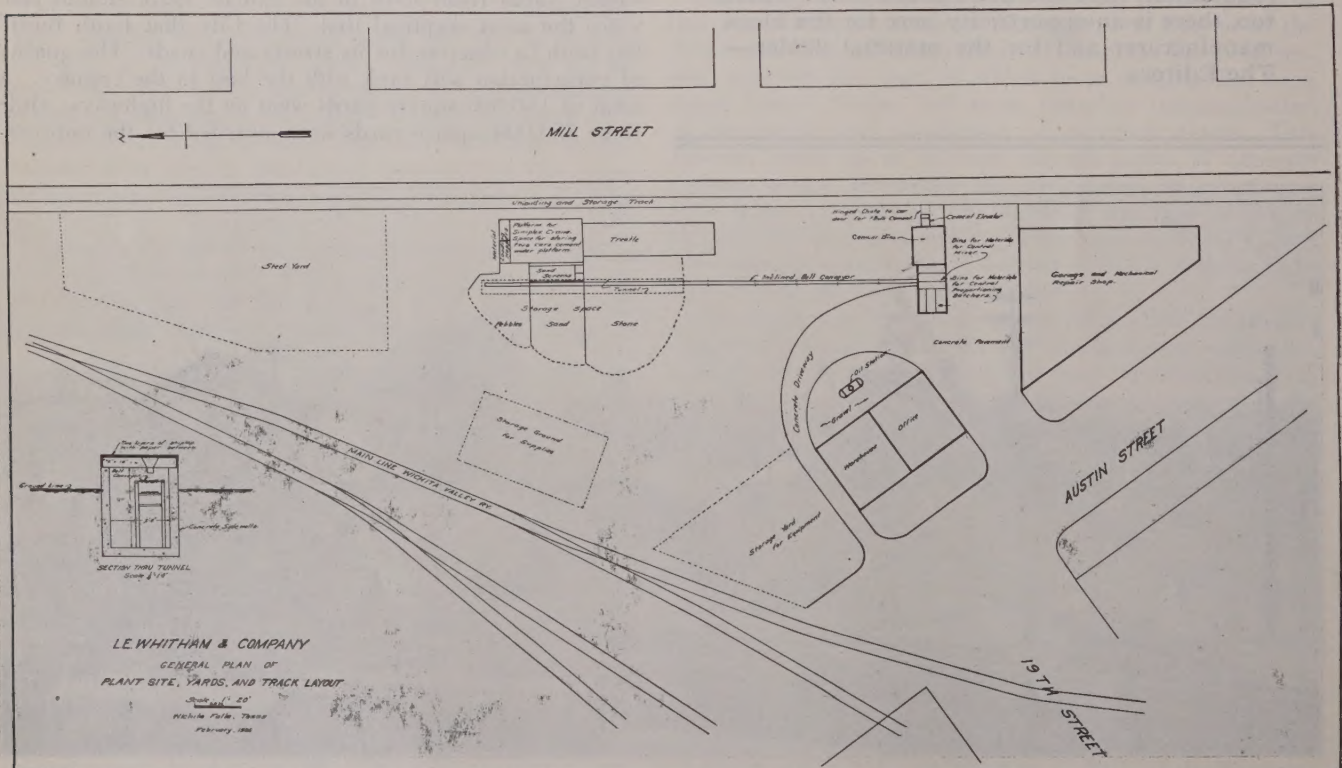
The sand for the mixtures is obtained by screening bank-run gravel received in cars from Chillicothe, Texas. The crane empties its bucket into hoppers placed directly over two vibrating screens placed side by side, which separate the sand and the pebbles. Two screens are used to increase the capacity and to allow one of the screens to be repaired, if necessary, while the other remains in operation. The sand and pebbles are directed into separate compartments, as shown on the accompanying layout. Crushed stone is placed in a similar compartment. A 100-foot concrete tunnel runs under these piles of material. An 18-inch Link-Belt conveyor is located in this tunnel and gates spaced 8 feet apart in the top of the tunnel permit the drawing of any class of material as needed. The pebbles are drawn onto the belt along with crushed stone. The grading of the coarse aggregate is improved by the mixing of these two materials.

When the plant is shut down on account of bad weather or other reasons, and materials continue to arrive, it is necessary to move the materials back and pile them higher than the reach of the crane boom permits. This is done with a scraper and double drum winch mounted on a Fordson tractor. Cars are switched by a Fordson tractor, but an electric car mover is being installed.

The belt conveyor elevates the material to the top of the plant proper, where a swivel spout enables the operator to deliver it to any one of the six bins located in the tower. Three of the bins are located over Blaw-Knox measuring boxes, which discharge into the central mixer; and three over Blaw-Knox boxes which permit the delivery of dry measured materials direct to trucks. Both dry and wet mixtures are trucked from the plant at the same time.

Bulk Cement Used

This is the only plant in Texas using bulk cement. The cement is received in box cars, which are spotted opposite a hopper on the side of the plant facing the unloading track. A Weller power shovel is used to move the cement



The general layout of the plant site, buildings and tracks, together with a section of the tunnel which contains the belt conveyor

from the car into the hopper, which in turn feeds an enclosed Link-Belt bucket elevator that carries the cement to the overhead storage bins. The bins will hold about five cars of bulk cement. The cement needed for the central mixer is drawn by gravity into a measuring box, which empties into a spiral conveyor that takes the cement for each batch to the mixer. Cement for the dry proportioned batches is drawn through a gate in the side of the bin to a small compartment adjoining the Blaw-Knox batchers and is measured by means of a gated box and dropped into the trucks. The normal output of the plant calls for the daily use of between three and four cars of cement. Mr. Whitham has found that the use of bulk cement brings about a considerable saving.

The Mixing Department

A T. L. Smith mixer is used and a batch of 0.55 of a cubic yard turned out every sixty seconds. The mixer discharges into a receiving hopper which allows two batches to be mixed and held ready for a truck, thereby enabling the mixer to run continually—permitting practically 100 per cent efficiency in operation. It is not uncommon for this mixer to turn out 460 batches, or 250 cubic yards of concrete in a ten-hour day.

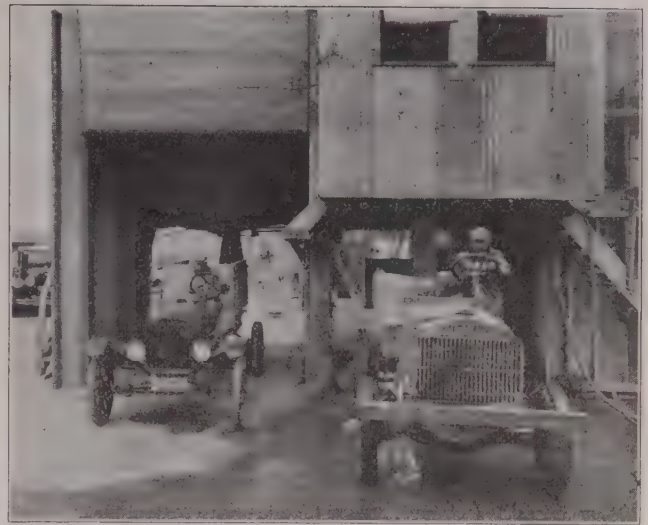
The method of operation enables the central mixer to produce concrete for one paving crew, while the other side of the plant is sending centrally proportioned materials to a paving mixer on another job, which, of course, is mixed and placed by an entirely different crew.

The production capacity of the plant is dependent on the ability to get materials from the cars to the piles over the tunnel. An output of 550 cubic yards of concrete per day is readily obtained, and a maximum of 650 cubic yards could be turned out under ideal conditions. This would supply enough concrete to place approximately 3,900 square yards of 6-inch pavement in one day.

Electrically Operated

No expense was spared in making the plant complete in every detail. With the exception of the cranes and Fordsons, the plant is electrically operated. This reduces the operating personnel to a minimum. Signals from an electric bell will cause any class of material to move promptly to the bins over the mixer. The inclined conveyor and entire mixing plant is housed and provided with doors and windows to eliminate the dust nuisance. The dust incident to the unloading of stone is eliminated by sprinkling. Folding doors enclose the openings in the doors of the cars of bulk cement. This arrangement keeps the wind from blowing the cement away while it is being unloaded. There have been no complaints from the people living near the plant.

The offices of the company are located within a few feet of the plant, allowing all operations to always be within



A wet batch is being received by the truck on the right, while a dry proportioned batch is being given to the truck on the left

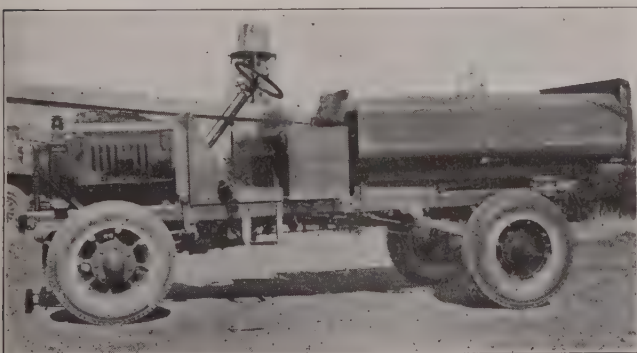
view from the manager's office. A truck garage and mechanical repair department are also on the property and a force of mechanics is available for equipment repairs. The grounds provide room for a steel yard and the storage of supplies and equipment. Driveways around the plant are paved with concrete.

The Plant Personnel

The plant now requires a personnel of 17 men for its operation, classed as follows:

- One plant foreman.
- One crane operator.
- One car switcher and operator of auxiliary crane.
- Two men cleaning up in cars.
- One man on gravel screens (removing oversize boulders, etc.).
- One man feeding material to tunnel belt (extra man needed when two materials are combined).
- One man distributing materials to bins.
- Three men unloading cement (unload three cars per day).
- One operator for central mixer.
- Two men operating measuring boxes (one set for mixer and another for dry batches).
- One man feeding cement to central mixer.
- Two men feeding cement for dry batches.

A number of devices will be installed shortly that will materially reduce the number of men required to operate this plant.



Special truck built by the Wichita Motors Company for L. E. Whitham & Co. The special body prevents spillage of the concrete and is instrumental in getting it to the job in good condition



Reinforcing mats are prepared at the plant and hauled to the paving site as needed. This view shows a mat being lowered into place



Ready-mixed concrete is delivered to city street work in trucks specially designed and constructed for the contractor. This simplifies the paving operation

Concrete Hauled in Trucks

Mixed concrete is hauled from the plant to the paving site in company-owned trucks, which carry 1.1 cubic yards per load. Recently in conjunction with the Wichita Motors Company, a special truck was designed and adopted as a standard for this work. Attention is called to the curved sides of the bed of this truck, shown in the accompanying view, which keep the concrete from splashing out. Proportioned batches of dry materials are hauled to the paving mixer in hired Ford trucks and paid for by the batch on a quarter-mile basis. No difficulty has been encountered in getting the concrete to the job in good shape.

Reinforcing Materials

Round junked oil field sucker rods, $\frac{5}{8}$ -inch and $\frac{3}{4}$ -inch in diameter, are used for a large part of the reinforcing placed in the pavement. These rods are delivered both by truck and rail from the nearby oil fields to the plant site, straightened and cut to proper lengths by a motor-driven bar cutter. With these rods and $\frac{3}{8}$ -inch round deformed bars reinforcing mats are constructed and hauled to the job as needed. These mats give an average of $7\frac{1}{2}$ pounds of steel per square yard of concrete pavement. The cost of such an unusual quantity of steel would be prohibitive if it were not for the saving made by the use of the oil field rods.

Paving Crews

As this article is being written, one paving crew is working on city streets, while another is paving a road for the county. The latter project is about three miles from the plant. These crews are, of course, entirely independent of each other, although under supervision of a general superintendent.

The crew on the city streets uses ready mixed concrete in the construction of reinforced concrete pavement with integral curb laid on sub-grade prepared by the city's forces. A modification of the Bates section is used. The pavement has a longitudinal joint in the center of the street on each side of which the edges are thickened to 9 inches. The integral curb serves as a thickened edge on the sides next to the property lines. Except for the edges, the pavement is $6\frac{1}{2}$ inches thick. The concrete mixtures are designed to withstand a compression test of 3,000 pounds per square inch. Reinforcing mats, as described under the head of "Reinforcing Materials," are placed in the neutral axis of the pavement. An unusual and notable feature of the work is the careful attention that is given to the securing of a high-class surface finish. The concrete is struck off and tamped by hand and a 1.1 mixture of cement and sand sprinkled over the surface. This is floated with long handled wooden floats; gone over both transversely and longitudinally with flexible boards, which are used instead of a belt, and finally troweled by hand with steel trowels. The final surface is true to $\frac{1}{8}$ of an

inch, when a ten-foot aluminum straight edge is applied longitudinally.

It would be almost impossible to handle the city work without a central mixing plant, for, like most street projects, the work is subject to many delays beyond the control of the contractor, such as the city's crew getting behind with the grading, water and gas line work, objections from property owners, etc. These inconveniences often cause the crew on city paving to work on as many as three streets in one day and the changes are made without stopping the operation of the plant. Such efficiency could not be obtained under the old method of placing concrete.

The crew on the County Highway project is placing a combination pavement similar to that described above and regular 18-foot Bates type. The latter width of pavement is placed between Blaw-Knox and Heltzel steel forms, enough forms for one-half mile of road being maintained on the job. As the trucks arrive with ready proportioned batches, they are turned at the mixer on a Blaw-Knox turntable and the material dumped into a six-sack Ransome paver. Water for the mixer and for curing is furnished by a Myers pump, belt-driven by a Fordson tractor. The pavement is covered with wet burlap immediately after finishing and later covered with earth, which is kept wet for a period of several days. The care that is taken to secure an even, smooth surface on the city pavements is also given to the County Highway.

L. E. Whitham is general manager of his company. His office manager controls the activities of a bookkeeper, a stenographer and two timekeepers, while a contract manager directs the work of a property owner contract representative and two men promoting new yardage.

Concrete That Can Easily Be Carved

Many articles that were formerly made of wood are being manufactured of gravel concrete on account of their longer durability and hardness. Some difficulty arises from the fact that most of them have to be fashioned at least at some places, which is not always easy with gravel concrete. But the latter combines homogeneously with a concrete made of asbestos and cement, which is workable, and is readily planed, cut, drilled, nailed, etc. It is important to see to it that, during the casting and tamping of such articles, the two sorts of concrete do not mix and that no gravel gets into the asbestos cement, which would hinder the working of it. Generally when filling the two different materials into the molds, metal slides are used for separating the masses. When the filling has been completed the slides are withdrawn. But the whole process requires much caution. If the slides are withdrawn too early the transgression of some bits of gravel into the asbestos cement during the stamping is not prevented; if it is done too late a reliable, firm connection of the inserted asbestos portions with the gravel concrete is not reached. At such places cracks easily appear or these parts separate in time owing to vibrations or other mechanical attacks.

A German patent has been granted for a process which uses tissues of thin wire, of asbestos fibres, or similar material, as a partition during the casting of such work, in order that both materials may be used at the same time. These tissues are not removed, but remain in the finished concrete article. Their meshes are of a size which prevents the transgression of gravel bits into the asbestos mixture, but wide enough to permit the common and homogeneous connection of both materials at the contact plane. An advantage of this process is that any kind of shape can be used. No cracks will appear, since the inventor claims that the asbestos concrete facing will not separate from its backing, nor will the other hitherto observed drawbacks be experienced.

EDITORIALS

What New Specifications?

Years ago when every engineer who made or specified concrete had his own particular idea of what constituted a good Portland cement, the cement manufacturers themselves saved the situation by formulating a standard specification which was high enough to please practically all of the contractors and engineers, and was stated in terms which permitted any well equipped cement plant to meet its requirements.

For years this specification has been the foundation for all our progress towards better concrete. It has made possible the statement of rules and formulas which would work out for any concretor, anywhere, because all concretors used the same cement. It has provided an ample safety factor which protected the general public against the dangers of bad concrete. And it has provided cement that would make much better concrete than the average constructor knew how to use.

But the situation is changing. Concretors are beginning to enjoy methods of sufficient precision to make the variations of cement within the limits of the Standard specification a matter of considerable moment to them. Designers are reaching the point where they sometimes would prefer to use a stronger concrete than can be made economically with our present standard Portland cement. Time is becoming a more important element as concrete is more widely and universally used as a general construction material, and hence a demand for quick setting cements of high strength.

It is up to the cement manufacturers to meet this situation, just as they did years ago when the present specification was developed. A new and perhaps a variable specification must eventually be worked out which will meet the requirements of the men who use cement without making unfair demands upon the producers. But this cannot be done until the new requirements are stated in reasonably definite terms. Concretors must determine with more accuracy what they actually need before they can expect the cement manufacturers to take action. When they have settled that question, we have no doubt but that the manufacturers will do their part, and do it just as satisfactorily as they did years ago when they created the present standard.

Central Mixing Again

Some state highway engineers may have thought that the idea of centrally mixed concrete had been finally put to sleep, but like many a good idea it will not down. Another plant, and a successful one, has come to light. It has operated with such success that it appears to bear promise of relative permanence. At this plant, the old objections to central mixing seem to be overcome.

Opposition centers upon the difficulty of delivering ready-mixed concrete over several miles of street and road without segregation, loss of cement and water, and loss of material. Batches must be delivered before initial set can take place. The drier mixes are known to be easier to deliver, but the drier the mix the more difficult would be the unloading and the handling on the job. At this plant the problem may have been given a solution.

Drier mixes have been made possible simply because

workability is gained by scientific proportioning. The trucks that deliver the concrete are so designed that they hold the material without its spilling over the sides of the body, and unloading is hastened by a high dumping angle and by the design of the dump body itself. The men on the job are getting used to handling the dryer mixes.

The result is that good concrete pavements are being laid when pre-mixed concrete is used, and the cost is within bounds of real economy. This example seems to indicate that the installation of a central mixing plant might prove a profitable venture for the contractor, the products manufacturer, or the material man, where the limiting territory would absorb the possible output of such a plant.

Standardized Aggregates

The importance of well graded aggregates is granted by everyone who uses concrete. But just how to get such aggregates is sometimes a problem of formidable dimensions. Sand and gravel come from all sorts of sources, no two of them just alike. The rough division into coarse and fine has a definite meaning for aggregates from the same source, but it doesn't mean much when two pits are supplying material on the same job. And in that fact lies one of the reasons for the wide variations noted in concrete which is made with the same nominal mix.

Contractors and products men have regarded this irregularity of aggregates as their own problem—one of the constant variables which it was their business to watch and beat the best way they could. But now comes the National Sand and Gravel Association—the fellows who have been producing these irregular aggregates—with a proposal for a standardized purchasing specification which would enable the concretor to get what he wants in terms of fineness modulus and size limits, regardless of the source from which his sand and gravel comes.

We think this is a step forward. It points the way to a solution, or at least a minimization, of one of the prime problems involved in making uniform concrete. The aggregate producers are doing their part by starting to provide a workable specification. It is now up to the concretors—contractors and products manufacturers alike—to get back of this movement with their help and advice if they really want to eliminate the irregularity of aggregates concerning which they have complained for so long, these many years.

Talking the Same Language

The business of making concrete is both an art and a science, and its principles are the same regardless of who makes the concrete or for what it is used.

No better example of this fact can well be found than the way in which concrete products manufacturers and concrete contractors are beginning to talk the same language. Fineness modulus, water-cement ratio, compressive strength, graded aggregates, and other terms of like import, are being heard of quite as frequently in the conventions of block makers as in the construction shanties of the engineers.

It's a good sign. It means that the concretor, wherever he is, is learning his business.

Designing and Building an Ontario Highway Bridge

The Situation Affecting Requirements of Design of the Freeport Bridge—Conditions That Had to Be Met—The Design Adopted—Parabolic Arch Ribs—General Features of Construction—The Working Schedule—Winter Protection of Concrete—Quantities Involved

By A. B. CREALOCK

Bridge Engineer, Department of Public Highways, Toronto, Ontario, Canada

The Provincial Highway System of the Province of Ontario, in the Dominion of Canada, is composed of some 1865 miles of main roads that serve the whole of the more populated section of lower Ontario. The roads on this system are built and maintained directly by the Province through the Department of Highways and the work is carried out through the head office, which is located at Toronto, and nine Resident Engineers that are located at different points throughout the Province. Since 1918, when the active road building program was started, the Department has paved over 1100 miles of hard surfaced roads, and has replaced 110 bridges, as well as building some 6000 culverts with spans varying from 20 feet down to 3 feet.

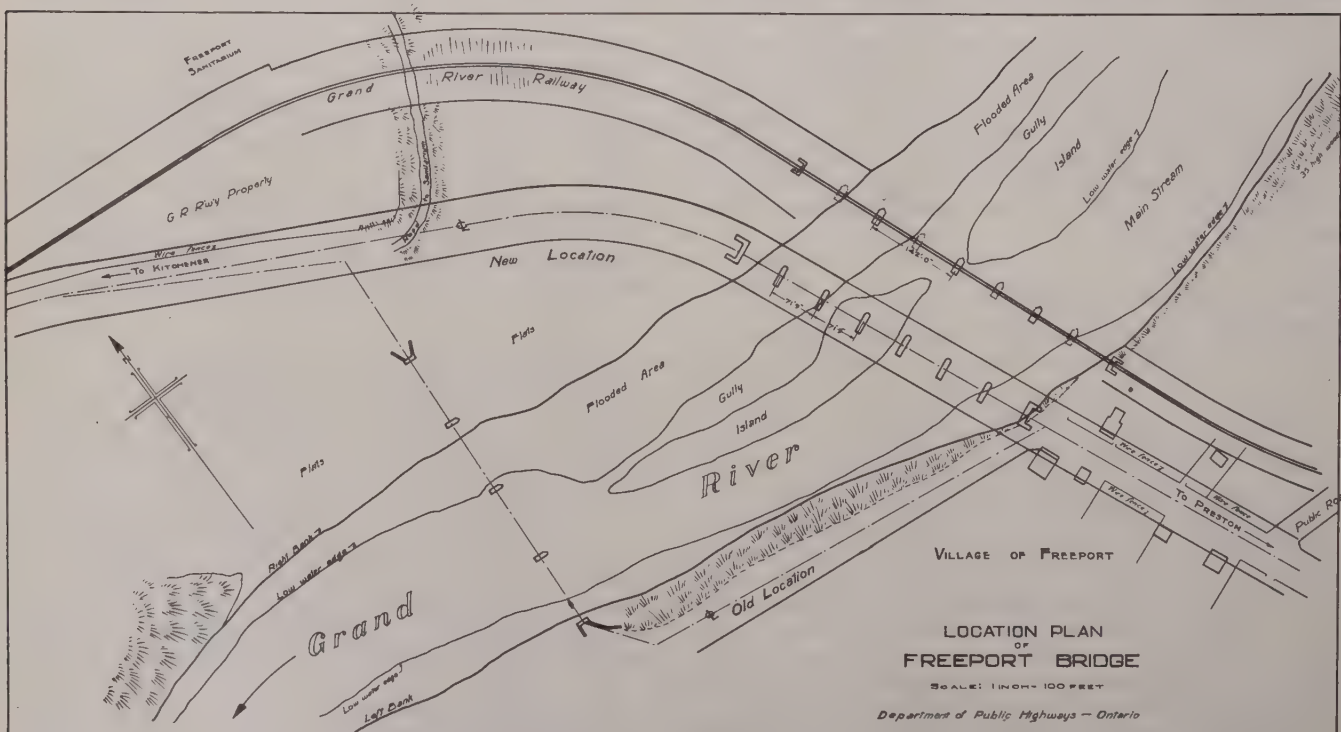
During the season of 1925, the Department built several bridges, one of which was a new reinforced concrete bridge at Freeport. This structure is located on the Provincial Highway leading from Hamilton to Kitchener and thence on to the northwestern part of the Province. The road carries a summer traffic of about 1700 vehicles per day. The Grand River, which this structure spans, drains a large part of the country, so that by the time it reaches Free-

port, the river is some 200 feet wide in the low season, which increases to about 500 feet in the flood season. The country adjacent is a fertile farming country and several thriving towns and cities are nearby. The locality is settled for the most part by people of German extraction and also by the Pennsylvania Dutch, who, when they left the United States during the years from 1785 to 1800, settled to till the fertile lands along the banks of the Grand River.

The old structure, which was built before the days of the motor car, did not at all meet the requirements of traffic conditions of today. The location plan shows several sharp turns, on most of which the vision of approaching traffic is almost entirely obscured. The roadway on the fill was narrow, while on the bridge the clear width only 15 feet, thus making it difficult for heavily loaded trucks to pass on the bridge. The old bridge itself was made up of four pin connected steel spans of 112 feet each with wooden floor, and was only designed for light loads.

The Relocation

The location plan also shows the new route made use of. By making a diversion of some 1200 feet, it was possible



to eliminate the dangerous curves and to procure a right of way with only one easy curve of some 550 feet radius and on which the view is clear from end to end, so that the fear of accidents need not be entertained. Of the 1200 feet mentioned, 500 feet is taken up by the new bridge and for the balance, the roadway is carried on a new embankment. In addition to the making of the new embankment, the approach grades at either ends are being regraded, so that at no place will the grade be over five per cent. The new bridge that is being built on this diversion is of reinforced concrete and will provide a permanent and safe crossing that will easily handle the traffic on this road.

In preparing the design for this bridge, there were several points that had to be considered. Of these might be mentioned the Grand River Railway which is an electric radial line that for several miles is either on the Provincial Highway right of way, or is on its own right of way parallel to the roadway. For some distance on either side of the Grand River the railway is within 100 feet of the highway and it crosses the river on a structure just on the upstream side of the new bridge. The railway company contemplated building a new structure about the same time as the Department, and the possibility of building a single combined bridge was gone into. The idea was discarded, however, as it meant that the highway would have to be diverted and the resulting route would not have been nearly as suitable as the one chosen and the resulting structure and grading would have cost as much as two separate bridges.

Designing the Bridge

The Department also considered the purchase of the old railway bridge and skidding the trusses downstream to the new location. The weight of a concrete floor of proper width stressed the trusses so that the safe live load would have been considerably less than our standards, and it was therefore decided to build an entirely new structure. Following the practice of the Department for the last three years, the structure was designed with a reinforced concrete superstructure supported on mass concrete abutments and piers. The loading used was class "C," which allows for a concentrated load of 20 tons or a uniformly distributed line load of 100 lbs. per square foot.

The railway company had already started reconstruction of their bridge and were adding three new piers midway between the old ones, thus reducing their spans from 142 feet to 71 feet. With this in mind, the new highway bridge was laid out with a distance of 71 feet 9 inches center to center of piers and placed so that they were directly behind the line of flow of the water from the railway bridge. The river level during the spring flood time rises as high as 15 feet above the summer level and it was necessary to design a bridge with as great a waterway as possible, and



The Freeport Bridge, as seen from the railway bridge. The hand-rail is under construction. This and the other handrail photographs were taken on May 13—just last month

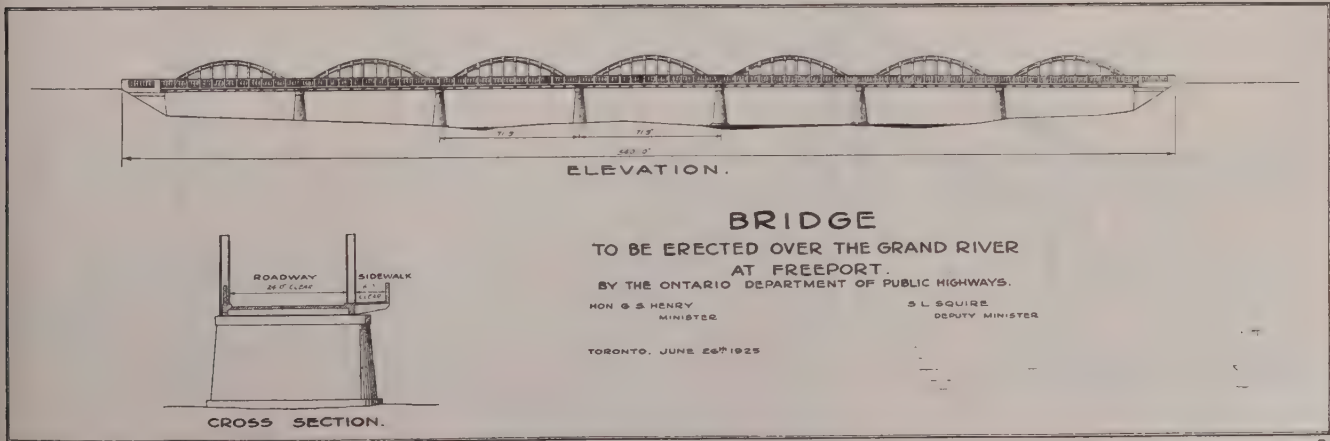
with a minimum distance between the crown of the road and the under side of the concrete. To the south of the bridge there are several houses facing on the road within a short distance of the bridge. In order to keep the property damages low and also not to have an excessive amount of fill on the north approach, it was necessary to keep the floor level as low as possible, considering the possible high water elevation. The level set gave a clearance of 2 feet 6 inches between recent records and the bottom of the concrete and is high enough that, should the water at some future time rise even higher, it will flow over the old road and cover a much greater area of the country before it would reach the bridge. This elevation places the bridge floor a distance of 20 feet above the normal low water level.

Seven Spans

The railway bridge to the east is composed of eight spans, but on the highway bridge this was reduced to seven, as this number met the banks of the flooded area and should be plenty to take care of the water. The material on which the bridge piers and abutments are placed is a



One end of the bridge, as seen from the west. The falsework has already been removed from one span



bed of coarse gravel varying in thickness from four to five feet overlying red clay cemented with gravel. This material was exceedingly hard to excavate and gave a splendid foundation on which to set the bridge. The footings of the piers in the main channel were carried down a distance of 6 feet 6 inches below the bed of the stream, or 8 feet below



Protecting the roadway from frost during the coldest part of the winter. Arch ribs are being erected



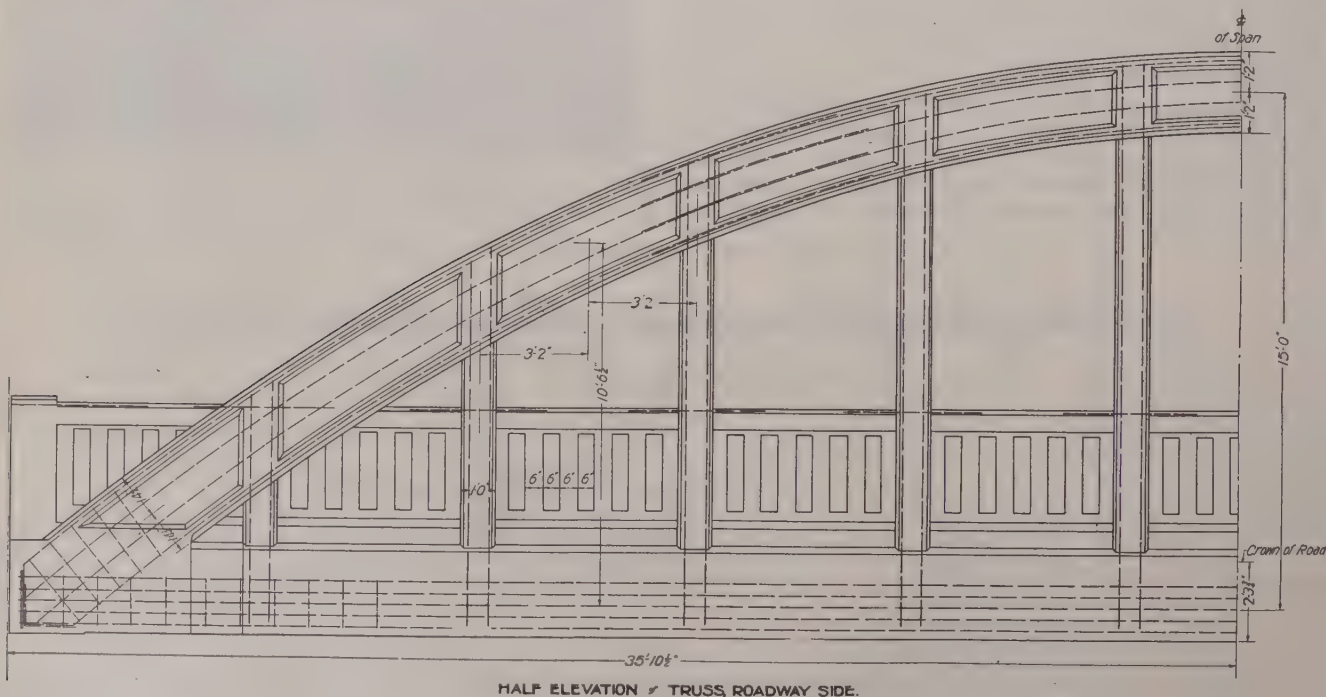
Placing the steel reinforcing for the arch ribs and floor slab of the south end of the bridge

water level, while the balance of the piers were carried down 7 feet. The south abutment was carried down 5 feet and the north abutment 1 foot. Although these footings are not as far below low water level as the piers, the depth of material excavated is 8 feet, which is greater than any of the piers. The details of the abutments are similar to other bridges on the Provincial System and are U-shaped and of mass construction. It was desired to keep the bridge and piers at right angles, and as the angle with the stream is not far from a right angle this was done, and a semi-circular nose was placed on the piers for a cutwater.

The superstructure is composed of seven similar reinforced concrete truss spans. These are composed of eleven panels, each 6 feet 4 inches, making the total span 69 feet 8 inches center to center of bearings. Short panel lengths were used, the floor stresses being carried directly onto the floor beam, in order to keep the depth of the floor to a minimum and to simplify the forming of the floor. The total depth of the floor system is 2 feet $3\frac{3}{4}$ inches. The arch ribs are parabolic and have a rise of 15 feet 0 inches at the crown, while the floor loads are transferred to the arch rib by means of vertical hangers composed of rods encased in concrete. The roadway on the bridge is 23 feet 0 inches clear between curbs and one sidewalk 6 feet 0 inches wide is cantilevered out from the east truss. The sidewalks are dotted and panelled in the usual manner and have a fall of 1 in 48 to carry the water to the curb. The roadway has a cross camber of $1\frac{1}{2}$ inches and the whole bridge has a longitudinal camber amounting to 14 inches at the center. This camber is placed by increasing the height of each successive pier from the abutments to the center by 4 inches, while the central truss had permanent excess camber of 2 inches placed in it before pouring, in order that the two grades would meet at the center of the structure. The drainage of the bridge is taken care of by means of $2\frac{1}{2}$ -inch diameter pipe on each side of the floor and placed in the curb line at the center of every other panel which is at 12 feet 8 inch centers.

Heavily Reinforced

The superstructure is heavily reinforced with steel. The steel, with the exception of the $\frac{1}{4}$ -inch rods, being bent in the mill and shipped ready for placing in the work. The tie-rods in the lower chord were rolled specially for this



work and were in single lengths of 71 feet 3 inches, thus obviating the necessity of using turnbuckles or welds. There were 216 of these rods $\frac{7}{8}$ inch in diameter required. They were shipped on two cars and unloaded right beside the work, from the main line of the Grand River Railway, between trains. Steel expansion aprons, faced with bronze, were placed under one end of each span, while the other end was rigidly reinforced to the pier in order to take care of expansion. The joint in the floor was filled in with "Elastite" bituminous jointing, and made waterproof by caulking with oakum soaked in "Tarvia XC."

The handrail on the structure is of the open pilaster type and the arch ribs are panelled, while all corners are chamfered. All exposed surfaces, after being stripped, are rubbed to a smooth finish with carborundum bricks and the structure when finished will have an exceedingly good appearance. In the pouring of the concrete local gravel was used. It was secured from a pit about 1200 feet from the bridge. For the lower portions of the mass concrete, pit run gravel was used, while for the upper portions and for the superstructure the contractors erected a screening plant in the pit and the aggregate was recombined at the mixer.

Summer and Winter

The contract for the construction of the bridge was let on June 18, 1925, and the contractors started at once to pour all the concrete below water level. By the first of August the foundations had been completed and the upper mass work was started, together with the erection of the falsework. The contractors were also at work proceeding with the grading of the fill at the north end of the bridge, and moved some 13,000 cubic yards of material to make this fill, and to provide a new entrance to the Freeport Sanatorium, which is located just north of the bridge. Four separate sets of falsework were used (three of which were used twice) and seven sets of mud sills, so that when the posts were removed they could be re-erected at once under the next span. The roadway floor system together with the four ends of the arch rib were poured first and then the sidewalk brackets and sidewalks. After the floor had cured two weeks the falsework and forms were erected for the hangers and arch rib and pouring of the truss completed. The falsework was left in place for a minimum period of three weeks before being removed.

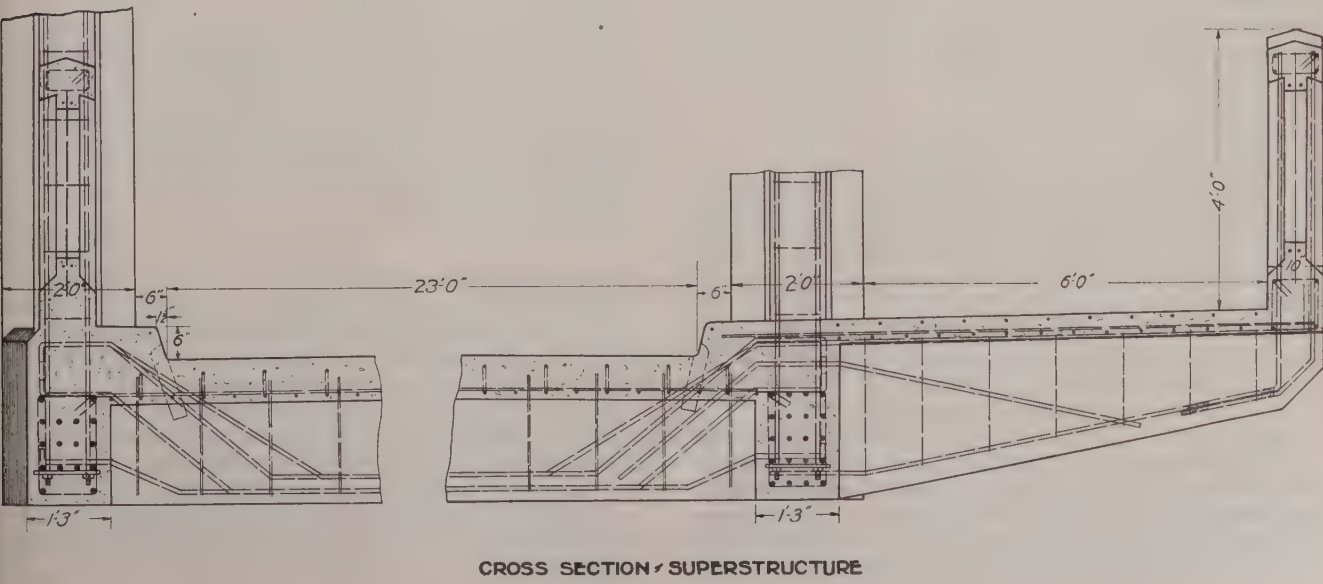
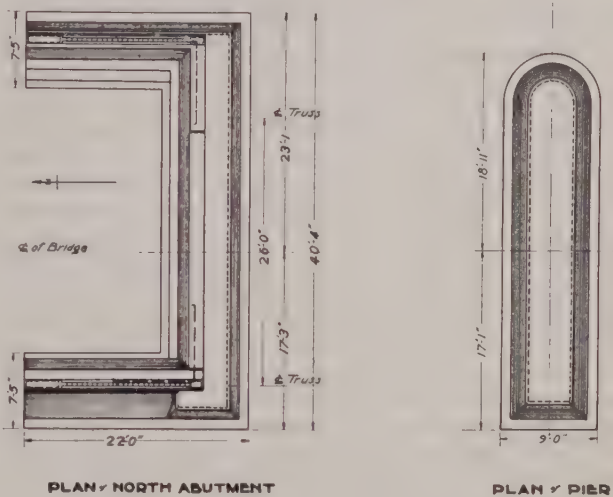
Winter Precautions

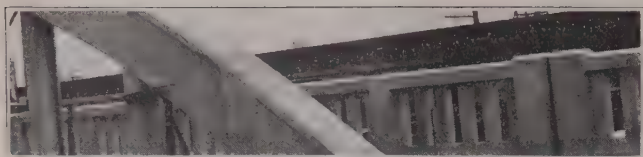
The three last spans were poured during the months of November, December and the first week in January, and

precautions had to be taken to protect the concrete from frost. Boilers were set up on the completed spans and all materials were heated by steam before being placed in the work. To protect the concrete after pouring, the outsides of the lower falsework were boxed in with heavy tar paper for a depth of 10 feet from the bottom of the concrete, and tarpaulins were hung from this point to the ground on the windward side. Before pouring, the forms were all



View of bridge on the sidewalk side, south end, with the concrete mixing plant and tower hoist





View of an arch rib, handrail and sidewalk on an end span



The handrail on the roadway side of the bridge. The work is rubbed with a carborundum brick after the forms are stripped

steamed out and several salamanders were suspended under the floor forms, and these were kept lit until the concrete had set so that all danger from being affected from frost were removed. Immediately after the floor had been screeded and finished the concrete was covered with straw and tarpaulins and steam lines were fed under the tarpaulins. In pouring the arch rib, the entire rib was surrounded by tarpaulins falling to the floor, and heat was provided by means of the steam lines and salamanders. By means of this protection, all frost was out of the materials before they were mixed, and the temperature of the surrounding atmosphere was kept at between 60 and 65 degrees, although the temperature at times was down to 12 degrees above zero on days that pouring took place.

Work on the bridge was shut down from the 10th of January until the first week of April with the exception of one or two men removing the falsework. At the present time the contractors are building a culvert connected with the work and are busy erecting the handrail on the bridge. The grading of the south approach amounting to some 7000 cubic yards will be started shortly and it is expected that the bridge will be open for traffic before the first of July, or practically one year from the date on which construction was started.

Materials Required

The quantities involved in the construction of the bridge and approaches amount to 960 cubic yards of earth excavation for the accommodation of the structure. The quantity of concrete poured amounts to 1915 cubic yards of mass concrete and 916 cubic yards of reinforced concrete, together with 1010 lineal feet of handrail. There was also 120 tons of reinforcing steel placed in the structure. The grading of the approaches amounts to 20,000 cubic yards. The total cost of the bridge and diversion, including the grading and land damages will be about \$80,000.

The structure was designed in the department's head office at Toronto and the construction was carried on under the supervision of George Downey, resident engineer of the department, who is located at Stratford. The complete work was carried out under one contract and this was let to Messrs. Campbell and Gzowski of Toronto.

Using Garbage-Concrete as a Home-Building Material

The workers of Great Britain are so hard-pressed for satisfactory homes at a price that is warranted by the present serious industrial conditions facing the country that they have at last taken to the use of garbage-concrete! According to our London correspondent, a house of this type has already been built and has proven quite satisfactory from the standpoint of wall insulation. The cost of a five-room bungalow of this kind, it is said, does not exceed \$1,250. This type of construction has been developed in St. Paul's Cray, Kent County, England, by T. H. Nash.

The building material is concrete, and in its employment an important difficulty is said to have been solved, that of the elimination of condensation. Mr. Nash has succeeded in producing a concrete block which has a dense outer layer that withstands the weather, a porous inner layer, and an inner side that affords a surface that will take either wall paper or paint.

The raw material used is house garbage, stored long enough to allow the organic material to become thoroughly decomposed, and then put through a $\frac{3}{4}$ -inch screen. The matter that cannot pass this mesh is washed and then used for the inner side of the block. The outer layer of the block is made of broken clinker and ashes that will pass the $\frac{3}{4}$ -inch screen. The fine material, mixed in the proportions of six parts of the aggregate to one part of portland cement, is first placed in the bottom of the mold. The center portion is then filled with the coarser material, and while still soft is given a thin dressing of Keen's cement. Within a few hours the forms may be stripped. It is claimed that the porous layer has a sufficient insulating value to prevent condensation.

A standardized production system is used in the manufacture of the precast units. The block are 4 ft. 3 in. long, 1 ft. high and 6 in. thick. They are cast four at a time on a thin frame.

The house constructed is a bungalow, 24 ft. by 28 ft., and was erected with unskilled labor. It is estimated that two men could make block and erect two such dwellings therewith in about six weeks. The building is very pleasing and arranged for the convenience of the housewife. The rooms open off a half-passage, at the end of which is the bathroom. The living room is light and airy, and although the bedrooms are rather small they provide private quarters for the various members of the family that are so frequently lacking in the dwellings provided for the rural workers in England.

Mr. Nash and his associate, Mr. Smithers, have interested themselves in this problem with a view of showing that the rural housing problem can be readily solved, and they have arranged to supply sets of plans for a small fee to any one interested in erecting a house of this kind.

The building has been inspected by members of Parliament, an official of the ministry of health, and has qualified by the state subsidy.

The National Slag Association, 933 Leader News Bldg., Cleveland, O., held its ninth annual meeting in the Old Colony Club, Cleveland, on April 9. Every director was present. The honor guest of the convention was P. H. Bates of the U. S. Bureau of Standards.

During the annual business sessions the following officers were elected to succeed themselves for the coming year: President, C. L. McKenzie, president, Duquesne Slag Products Co., Pittsburgh, Pa.; vice-president, C. E. Ireland, vice-president, Birmingham Slag Co., Birmingham, Ala.; secretary-treasurer, H. J. Love, 933 Leader-News Building, Cleveland, Ohio.

Concrete Discussed at Code Conference

Code Requirements for Concrete, and Other Matters Discussed at Building Officials' Conference—Uniform Codes on Pacific Coast—Block and Tile—Concrete Brick—Inspection of Structures

The Twelfth Annual Building Officials' Conference held a four-day session at the Neil House, in Columbus, Ohio, from April 27 to 30 inclusive. While no registration list was available at the close of the convention, the attendance exceeded that of previous years and the interest shown was up to the usual high standard. This is a commendable showing, inasmuch as this organization has a rather high membership mortality, because of the frequent changes in city administrations. Existing members drop out of office and the newly appointed officials do not in all cases re-establish the contact.

The subjects treated in committee reports and papers covered a wide range. Lack of space will make it necessary to confine this report to a discussion of those in which readers of CONCRETE will have particular interest.

Stucco

The Report on Stucco, presented by Fred W. Lumis, Inspector of Buildings of Springfield, Mass., chairman of the committee, was similar to last year's progress report, printed in the 1925 Proceedings of the B. O. C. This year the Lumis report was accepted as a final report. During the convention many officials visited the model house now being built by a Columbus daily newspaper. The walls are built with California cement stucco on concrete block.

"Uniform Building Code for Pacific Coast Cities," was the subject of a paper by H. E. Plummer, Building Inspector of Portland, Oregon. The discussion was led off by A. C. Horner, Inspector of Buildings of Stockton, Calif., and secretary of the Pacific Coast Building Officials' Conference. Mr. Plummer and Mr. Horner both traced out the progress of the building code work undertaken by the Pacific Coast Conference, and told of the meeting to be held in Sacramento, Calif., during the week beginning May 24, when the final draft will be formulated and the code will then be printed. The sponsors of the proposed code expect it to be adopted, with perhaps minor changes, at the September meeting of the Pacific Coast Conference. Others who discussed the paper expressed surprise at the progress being made by the Pacific Coast officials toward the adoption of a uniform code. The draft now under consideration was prepared by a committee of building officials who followed the outline recommended by the Department of Commerce Building Code Committee.

Safeguarding Old Buildings

The paper on "Safeguarding Old Buildings Against Fire," read by E. M. Lurie, of the Associated Metal Lath Manufacturers, was illustrated by a number of large-scale drawings. Mr. Lurie emphasized the advantages and possibilities of protecting vulnerable places in old buildings through the application of metal lath and cement plaster. Several of the illustrations showed extremely hazardous condition existing in old buildings, although a survey of old structures will probably disclose the conditions shown are typical of thousands of others. Through the construction of bulkheads, ceilings, partitions, walls and linings of metal lath and cement and plaster, Mr. Lurie pointed out,

many old buildings may be made fairly safe at a very moderate cost.

"Inspection of Structures at Owners' Expense," a paper read by Edward C. Kerth, who was for twelve years Commissioner of Buildings of Evansville, Ind., proposes thorough inspection of buildings under the direction of the city building department, but at the expense of the owner. The proposal to put the plan into effect inspired a lively discussion. A model ordinance was incorporated in the paper.

Inspection of Structures

The discussion was led by Col. John W. Oehmann, Inspector of Buildings for the District of Columbia. The new code of the District, adopted July 1, 1925, provides limited inspection at owner's expense on all buildings intended for public assemblage, and all other buildings utilizing more than 100 tons of structural steel or more than 20,000 square feet of reinforced concrete floor area. Col. Oehmann expressed the opinion that the proposed ordinance involves a delegation of authority to private individuals. This, however, was stoutly denied by Mr. Kerth and others who discussed the paper. Mr. Kerth explained that he had submitted the model ordinance to legal opinion, and that it does not in any way involve delegation of authority to private individuals. Col. Oehmann, however, is favorable to the general principle of inspection of structures at owner's expense.

Rudolph P. Miller, Consulting Engineer of New York City, formerly Building Commissioner of New York City and president of the Building Officials' Conference for 10 years, expressed the opinion that the plan to provide inspection at owner's expense would be found entirely feasible, and that the proposed ordinance does not involve delegation of authority. On the contrary, he explained, there is much precedent for such an arrangement in the present system in many cities of accepting the inspection of underwriters on electrical work. Mr. Miller was followed by Deputy Building Commissioner Knight, of Chicago, who took the opposite view, claiming that the method would not be legal in the state of Illinois. Mr. Knight was followed by President Burton, Commissioner of Detroit, who said this method of inspection would be legal in Michigan, that he considered it entirely feasible, and suggested that building officials and structural engineers interested in such an ordinance might well co-operate with legal authorities in formulating the ordinance. He pointed out the need for better knowledge of legal matters on the part of structural engineers and building officials, and contended that even in states where laws now seem to be an obstacle, such obstacles could be overcome if properly approached.

Laboratories Were Visited

The afternoon session of April 28 was taken up with an inspection trip through the Ceramics Research Laboratories of the U. S. Bureau of Mines, located at Ohio State University, and a trip to the Engineering Laboratories of the University. During the progress of the inspection trip

tests were made on a hollow concrete block, which failed to crush at 1810 lbs. per sq. in. over the gross area, under the 200,000 lb. testing machine.

Block and Tile

The Committee on Hollow and Solid Building Units, of which the chairman is W. C. Muehlstein, Building Engineer for the Industrial Commission of Wisconsin, presented its report. This report is divided into two parts, one covering hollow units and the other covering solid units. Both reports were signed by all members of the committee present. These consisted of the chairman, Mr. Muehlstein; Robert Knight, Deputy Building Commissioner of Chicago; J. R. Hesser, Inspector of Buildings of Toledo; H. R. Kingsley, of the Hollow Clay Tile Association; Charles A. Bowen, of the Common Brick Manufacturers Association; and Norman M. Stineman, of the Portland Cement Association. Robert K. Cochran, Inspector of Buildings of Pittsburgh, is the remaining member of the committee, but he was not present.

The report on hollow units, insofar as it relates to concrete block and tile, recommends an average crushing strength of not less than 700 lbs. per sq. in. over the gross area, and an absorption not exceeding 16 lbs. of water per cubic foot of concrete in the unit. Hollow clay tile as well as hollow concrete block and tile must be branded. Neither material is recommended for use in bearing or exterior walls of a height greater than three stories or 45 ft., except that they may be used in exterior panel walls in buildings of any height.

What Are Brick?

In the report on solid units the definition of "brick" is specifically made to include any material that meets the strength and absorption requirements. No definite mention of any material is made. Solid units are divided first into two general classes, one designated as building brick and the other as solid building block. A solid building block is any solid unit with dimensions varying more than 3 per cent from the standard brick dimensions. Building brick then are divided into three grades, hard, medium and soft. The average crushing strength for the three grades, in the order named, is placed at minimum figures of 3,500, 2,000 and 1,000 lb. per sq. in., respectively, and the absorption at 16 per cent, by weight, for the hard and medium grades, with no absorption limit imposed on the soft grade. All building brick not of distinctive design or appearance by which the manufacturer may be identified must be marked or branded. In this respect the report is introducing a new requirement so far as building brick are concerned, although this is a customary requirement in modern regulations affecting hollow units.

That part of the report relating to hollow units was accepted on April 29 as a final report. The part covering solid units, having been presented for the first time, also was accepted and takes the status of a tentative report. It will be presented in final form next year.

Manufacturers and Officials

Albert E. Kleinert, Superintendent of Buildings for Brooklyn, N. Y., attracted much favorable attention when he read a paper on the subject of "Developing Co-operation Between Building Departments and Structural Material Producers." Mr. Kleinert told first of the co-operation he is getting from the Brooklyn Concrete Products Association and the Portland Cement Association in connection with block regulations and the inspection of that material, and of the further co-operation from the Portland Cement Association in connection with the inspection of concrete work in cold weather.

An extended discussion of Mr. Kleinert's paper fol-

lowed, during which Building Inspector Hopkins, of Providence, told of similar arrangements he is making with the Portland Cement Association. Building Commissioner Burton, of Detroit, told of the arrangements now being formulated by the Detroit Concrete Products Association in connection with their proposed field inspection. Commissioner Walters, of Columbus, told of the co-operation he is obtaining from the Portland Cement Association and the Columbus Concrete Products Association, and he praised the high quality of products made there. He made particular mention of the fact that many of the block being sent to the laboratory and tested with the 200,000-lb. machine cannot be broken, thereby indicating a strength over gross area exceeding 1800 lbs. per sq. in.

Election of Officers

The new president for the forthcoming year is H. E. Plummer, Inspector of Buildings of Portland, Ore. The new vice-president is W. C. Muehlstein, Building Engineer, Industrial Commission of Wisconsin. J. F. Downey, Commissioner of Buildings of Cambridge, Mass., was re-elected secretary and treasurer. New members of the executive committee are F. S. Anderson, Inspector of Buildings of Evanston, Ill.; John Fowler, Building Commissioner of Jacksonville, Fla.; and George W. Sherman, Building Commissioner of Worcester, Mass.

To Promote Use of Odd Sizes of Lumber by Industry

As a result of the meeting of the National Committee on Wood Utilization held in Washington recently in the Department of Commerce, Secretary Hoover, chairman of the committee, announced that two definite projects were already under way in the nation-wide effort for a more complete utilization of lumber from the time it leaves the forest until it becomes the finished product.

The promotion of the use of short lengths, odd widths and odd lengths of lumber, including end matched material, and a campaign for the better seasoning and piling of lumber, are two first major wood-saving steps to be taken, it was reported. The conference has selected these projects and will proceed through educational and other methods to make them an effective part of the activities of the wood-using trades on behalf of better wood utilization.

A special committee to develop and extend the greater use of short and odd length sizes and odd widths is being organized representing the associations concerned in manufacture, wholesale and retail consuming trades, architects, contractors and engineers.

According to Axel H. Oxholm, director of the National Committee on Wood Utilization, providing a market for short and odd lengths and odd widths is one of the most important of the wood-utilizing problems in the soft-wood industry today. He estimates that a saving of from \$100,000,000 to \$150,000,000 a year would result if these sizes were produced and marketed. Mr. Oxholm contends that the consumer naturally has to pay for this avoidable waste.

The logger and manufacturers, in cooperation with distributors and consumers, are setting up a special committee to study the best methods of better seasoning and piling of lumber, and have recommended that this committee should compile information on the best known and new methods of lumber seasoning and handling. This special committee will be made up of representatives of lumber manufacturers, wholesalers, retailers and industrial users. Insofar as seasoning and piling of lumber is concerned, Mr. Oxholm says that there is a very large and avoidable waste from the time the lumber leaves the sawmill until it is put to final use.

Making a Profitable Art of Cast Stone Manufacture

Onondaga Litholite Company Builds Important Business Upon the Quality and Architectural Correctness of Its Products—Only High-Grade Cast Stone Manufactured—Organization—Shop Methods—Sales Policy—Scope of Work

By OTTO A. STELLER

TWENTY years ago a products manufacturer of vision saw the great potential market for concrete cast stone. He believed that if he manufactured a high grade product using the best materials available, and then sold it on a quality basis alone, he would be able to convince architects that, from the standpoint of appearance, adaptability, and weathering qualities, no other material could equal cast stone. Deliberately, at the very beginning of his enterprise, he subordinated the question of cost and price competition with other building stones. He picked as the market for his material monumental buildings such as banks, churches, hotels, etc., where cost is less important than appearance.

Years of effort along these lines have brought the success that justified his belief. For out of that conviction grew the present mammoth plant of the Onondaga Litholite Company at Syracuse, N. Y.—a plant in which estimates are made each month on work valued at more than \$3,000,000, and in which cast stone averaging about a quarter million dollars in value is contracted for each month.

Cast stone manufactured in the plant of the Onondaga Litholite Company has been used on many of the nation's finest buildings and more than 500 banks have chosen it. The product is used from the Atlantic coast to the middle west and the company maintains offices in New York, Philadelphia, Baltimore, Pittsburgh, Erie, Pa., Johnston, Pa., Columbus, Ohio, and Chicago.

Office Organization

The present plant of the Onondaga Litholite Company has a capacity of 600,000 cubic feet of stone per year.

Each order is handled according to a standard procedure from its initial stage in the drafting room through every process in its manufacture. A special department, known



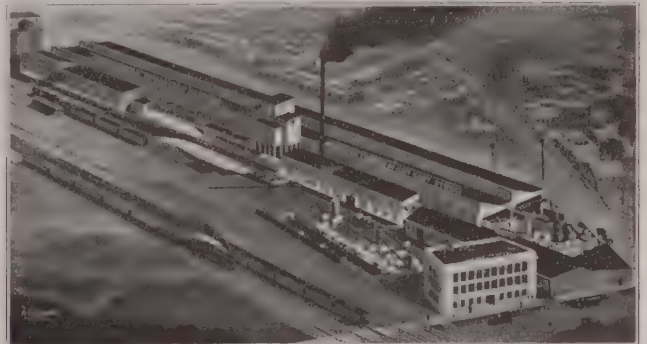
The drafting room, where work is estimated and shop details are drawn

as the Production Department, takes the contract as soon as it comes in and routes the job through the plant. Schedules are worked out so that the various cast stone units will be completed in the order in which they are needed in the building. After the job is turned out of the shop, the traffic department takes hold of it and insures the prompt and safe delivery of the units. This department will, if it is necessary, send a representative to the job to superintend the unloading of the cast stone. The architects and contractors are kept informed of the progress of the work by means of reports and shipping lists. In a spirit of complete co-operation, a man from the plant is often sent to the job to supervise the erection of the units.

The office organization includes a sales department, a finance department, an estimating department as well as the production and traffic departments. In the large, three-



The original plant, where the company had its small beginning twenty years ago, is shown in this sketch. Compare this to the sketch of the plant of today



This big modern plant now houses the company. From this factory 600,000 cubic feet of cast stone are shipped to the east and middle west each year



A portion of the modeling department, where the models and molds are made for the more intricate pieces. Nothing is too difficult for the master craftsmen of this department

story office building at the plant these departments are housed on the first floor. The second floor houses the drafting room with approximately 20 drafting tables. Here the detailed shop drawings for each individual unit are made from the architect's plans. On the third floor is a large layout room where difficult designs can be laid out to full scale.

Shop Organization

Pattern shops, modeling and plaster mold department, casting department, and finishing departments are housed in the big shops. Between 300 and 500 men, as well as foremen in charge of each department, are employed in the shops.



One drum mixer and the overhead crane carrying one of the special electric mixers, ready to fill several sand molds that have been made on the floor

To manufacture the many special designs and the ornamental work for trim stone and decorative carvings, men of special skill were required. This department, employing skilled modelers and carvers, are experts in carrying out designs roughed out by the architects. Photographs of clay models are submitted to the architect and changes are made until they meet with complete approval if the architect is unable to supervise the work in person. Intricate designs in columns, cornices, tracery windows, panels and pediment ornaments have been cast with complete success. It is in this specialized work that the Onondaga Litholite Company has stepped out of the ranks of the products manufacturer as he is commonly regarded, and has entered the ranks of the artist.

Plaster waste molds are made from the approved clay models into which the concrete is cast. If duplicate casts are required, a glue model is made that accurately reproduces the clay model. This method permits the casting of any number of units from any one particular design.

For the less intricate designs, such as moldings, railings, and plain slabs, wood patterns are used. These are placed in sand beds and the sand carefully tamped around them. After the patterns are removed, the sand accurately reproduces the contour of the pattern. Long rows of sand beds extend the entire length of the shops. In them are all manner of molds, from plain slabs to units of intricate sculpture.

Reinforcement rods are placed in some of the larger molds. Anchor bolts are placed, and lifting hooks are fastened in the forms, to facilitate the handling of the units after the concrete has hardened.

Overhead is an electrically operated crane from which is suspended a specially designed electric mixer. The mixer receives its charge of aggregate and cement from the bins along one of the walls of the casting room. After the concrete is mixed the mixer is moved directly over the sand molds. In casting, the mixer is lowered directly over the mold, releasing a flow of concrete through a funnel into the mold. Two of these mixers, each with a capacity of a cubic yard of concrete at a batch, are in service. Constant agitation keeps the material thoroughly mixed until it is deposited.

Proportioning

Aggregate is taken from the Onondaga Litholite Company's own marble quarries at Gouverneur, in northern New York, which produce a very hard grade of stone. The



The casting room where sand molds are used just as in a foundry. An overhead crane handles the heavier work and distributes the concrete from an electrical mixer which it carries

marble is shipped in large pieces to the plant at Syracuse, where it is prepared for use. After preliminary crushing in large roller jaw crushers, the material is still further reduced in a disc crusher and by the use of manganese rolls. The sizes of the aggregates ready for use range from fine sand to half an inch. Each size is segregated by means of power screens and stored.

In preparing the aggregate for mixing, the various sizes are combined according to formulas developed through experiment. In the many years of experience accurate records have been kept of the proportions used in all the stone manufactured and those giving the best results have been adopted as the standard formulas. New conditions continually impose the need for new formulas and experiments on new combinations are made to meet new requirements. The formula used for each order is carefully recorded and filed so that it will be possible to duplicate any order. The color of the stone is determined by the color of the aggregate used and by the combinations of aggregates selected. It is also possible to use various mineral colors in combination with the aggregate to produce stone of a certain desired color or to match natural building stones. Contrasts can be obtained by a mixture of aggregates with sharply contrasting colors—as, for instance, by mixing a white marble with a black aggregate.

All materials are proportioned by weight. Definite amounts of the various sizes and colors of aggregates are weighed according to the formula and combined with definite amounts of cement and water, which are also measured by weight. By this method absolute uniformity of color and strength is assured.

Finishing

After the cast has hardened sufficiently it is removed from the sand molds by the electric overhead crane and carefully stored for curing.

It is in the matter of developing finishing methods for cast stone that the Onondaga Litholite Company has made another valuable contribution to the cast stone industry. Every finish that has been used in the past on natural stone is available in a wide variety of colors and textures. All exposed surfaces are re-cut either by machinery or by hand. Never is a stone sent out as it comes from the molds. This policy of re-cutting every unit, while it is expensive, adds so much to the appearance of the unit that it more than pays for itself.

Carborundum machinery is used for machine finishing. Carborundum saws cut the cast stone into the required



Another view of the modeling room, where the finishing touches are being put on the plaster mold for a great capital

lengths and carborundum planers cut the surfaces to insure sharp arrisses and true lines and angles. Rubbing beds are used for ashlar work.

All cast stone units that are irregular in surface are re-cut by hand. From 40 to 80 stone cutters—the largest force of expert stone cutters for the production of hand finishes in the United States—are regularly employed for this work. They use the same hand tools and methods that are used in cutting and finishing natural stone.

Tests

Throughout the manufacturing process rigid inspection is maintained. Weights are carefully checked and the amount of water is very carefully observed. The units are closely watched for measurements in every operation.

As most of the material manufactured is used for veneer or for ornamentation the matter of strength is of secondary importance. Yet strength tests are made regularly



One of the finishing machines at work on a huge block of cast stone. It will be hard to tell this piece from natural granite



The pattern shop where wood patterns and cores are made for use when clay models and plaster molds are not required



Another view of the finishing department, with the huge saw, the rubbing beds and other stone-cutters' equipment. An overhead crane moves the work through the shop

when a new formula is developed, and the results always are far greater than are required. Tests reveal the strength as being strikingly uniform at about 6,000 pounds per square inch. With the method adopted of using a predetermined amount of water for each bag of cement used, the strength is bound to be uniform. The last time a strength test was demanded by an architect was eight years ago.

Absorption tests are made on each order. In every test absorption is less than 5 per cent.

Advantages of Cast Stone

There are many features that permit the use of cast stone at a considerable saving over the more expensive types of natural stone. There is a great saving in casting stone from clay models as compared to shaping and carving from hewn stone. This is especially important when many units of the same shape are used.

In large work it is possible to core the casts, reducing the weight and lowering the cost of handling and shipping. This is particularly advantageous in large columns where it is possible to provide a wall of sufficient thickness, reinforced with steel, to give the same strength as a solid column. Cornices, also, can be designed to permit coring



Two carborundum wheels that are used in planing the surfaces of the smaller pieces. Monorail overhead hoists are used to handle the pieces. Work tickets rest in a wall cabinet to the rear of the machine at the left

of the projection, lowering the weight of the overhanging portion and reducing the expense of holding them in place.

The fact that lifting hooks can be cast in all cast stone units simplifies the task of setting and handling. Where the stone is to be fastened to the structural members of a building, the necessary bolts and hangers can be cast into the stone.

Sales Policies

The product of the Onondaga Litholite Company has never been offered as a cheap building stone. It has always been sold entirely on its own merits, not as a substitute material, but as a new material with its own advantageous characteristics. It was offered as a quality material for monumental buildings because it expresses the dignity and character sought in high grade buildings. Then, too, it has such infinite possibilities in color, texture and form. It is a more flexible material than natural stone.

The cost of granite is in many cases prohibitive even for banks and other important buildings. Yet the prospective builder thinks of the structure as faced with granite or with some material equally as dignified and substantial. It is in that field that quality cut precast stone finds its most important market and it is this market that the Onondaga Litholite Company set out to cultivate.

To do this the architect had to be sold. Accordingly attention was focused on him and all sales efforts were directed toward him. The first step was to select the most important and influential architects designing the type of buildings in which cast stone could be used to best advantage. Salesmen representing the company called on the architect and told him of the *advantages* of cast stone. No attempt was made to compare the cost of this material with natural stones. The cast stone was sold only on its own merits. Then a catalogue was prepared, explaining the methods of manufacturing the cast stone and setting forth its advantages. This was followed by a cabinet containing samples of the most popular finishes and colors, which was given to the architect for his permanent use.

Service Is Paramount

One of the outstanding features of the service rendered by the Onondaga Litholite Company is its complete co-operation with the architect. This is instituted when the architect is first beginning to visualize the building. Any special color scheme that he may be trying to evolve is discussed with the cast stone manufacturer. Samples are then made up for the architect's consideration and ap-



Here a large staff of stone carvers are finishing parts by hand that cannot well be done by the machines. Pneumatic tools aid them in their exacting work

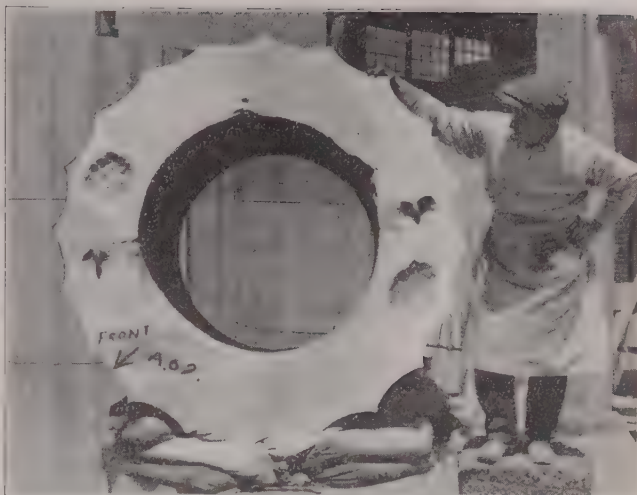


The shipping yard is provided with every facility for loading the finished stone into cars for shipment to distant work. Packed in shavings, the units will arrive at their destination in the best of condition

proval. When the right color and texture is selected the manufacturer's representative co-operates in the shipping, unloading and erecting of the material until the job is completed.

In this manner many of the foremost architects have come to rely upon the use of cast stone for ordinary as well as for exceptionally difficult projects and have come to turn to the company for help in working out unusual commissions.

One day an architect of enviable reputation told Mr. Warner, the president of the Onondaga Litholite Company, that he was planning a building that was to have an unusual color scheme and he did not know of a building material that would give him the results he wanted. Mr. Warner got his ideas and set about to make a sample of cast stone of the color wanted. He took this sample to the architect and found that it was not exactly the color he wanted. On the third trial he succeeded in finding the exact tone that the architect required, and, of course, the building was faced with cast stone. After that the architect knew that he was no longer limited to the colors and



Here is a cored drum for a great column, with others stored in the rear. Notice the hooks cast into the stone to facilitate handling in the shop and on the job, together with portions chipped away to afford a perfect balance to aid the stone-setters

textures of ordinary building stones. He had found a material that could be adapted to any need and he could design and execute without restriction so far as color and texture were concerned.

Competition Welcomed

The present large output of the Onondaga Litholite Company is the direct result of these policies. To the vision and perseverance of H. P. Warner credit for the outstanding accomplishment must be given. Mr. Warner welcomes competition. In fact, he considers the lack of competitors as detrimental to the cast stone industry. If more than the few concerns now making cast stone of that quality were in the field they would help to make cast stone a better known and more universally used material. There is a large undeveloped field for its use and the products manufacturer with capital and experience will find a steadily expanding, as well as profitable, market for quality cast stone.

Brick Scale Established for Concrete Products Shipments

Through the efforts of the traffic committee of the Concrete Products Association and the Concrete Products sub-committee of the committee on transportation of the Portland Cement Association, the Central Freight Association has established the principle that no higher freight rates should be charged on concrete block, brick, building tile or staves than on similar clay products.

With this principle established, concrete products manufacturers operating in Central Freight Association territory, desiring an adjustment of rates, should submit to the individual carriers serving each of their plants, specific requests for such rates as they desire put into effect. The shippers must represent to the railroads their need for a rate as low as that being obtained by competing clay products factories.

Specific rates from each point must be worked out separately and according to established procedure. This means that members of the Concrete Products Association within Central Freight Association territory must make application with the lines serving their plants, asking for rates on the same basis as clay brick, if brick rates are published from that territory; or comparable with clay brick rates from nearby brick producing points. The originating roads will then proceed in the usual manner, and with the

principle established as outlined above, there should be no trouble in getting specific rates authorized.

The traffic committee of the Concrete Products Association, of which E. W. Dienhart, Cement City, Mich., is chairman, in conjunction with the sub-committee of the Portland Cement Association, will be glad to assist products manufacturers in preparing applications to originating lines for proper adjustment of rates on their products.

The rates established should open up many new markets heretofore closed to concrete products manufacturers in Central Freight Association territory. Not only will the concrete products manufacturers be benefited by this ruling but the carriers will come in for a much larger volume of business through a greater movement of freight over their lines. The railroads in ruling as they did acted very fairly on the general proposition and deserve the full support and co-operation of the products manufacturers. The latter should be encouraged at every opportunity to investigate this new rate basis and consider the shipment of products over the lines of the railroads reaching their plants.

For the information of shippers, Central Freight Association territory embraces roughly the states of Ohio, Indiana, Michigan (excepting upper peninsula), points in Illinois south of a line drawn from Chicago to Peoria, and cities in Pennsylvania and New York included in the territory west of a line extending from Buffalo to Pittsburgh.

Standardization of Aggregates Needed

Sand and Gravel as Ordinarily Sold Show a Real Lack of Uniformity in Grading—Standard Aggregates Must Be Based Upon a Standard Set of Sieves—Methods of Job Control That Would Be Aided By Standardization—A Guide to Such Specifications

By STANTON WALKER*

This is a paper read by the author before the recent annual convention of the National Sand and Gravel Association. Since Mr. Walker discusses a question that is just as vital to the contractor as to the producer of aggregates, his paper is now passed along to the readers of CONCRETE in order that they may see for themselves just what it is that is under consideration by the producers. Mr. Walker has merely stated some facts, but his paper will no doubt lead to beneficial action.—The Editors.

Standardization is the slogan of modern industry. The need for it is pointed out in a report of the Chairman of the American Engineering Standards Committee for 1925 where it is stated that approximately 27,000 specifications exist for only 6,000 commodities. There is little doubt but that the multiplicity of standards for sand and gravel aids materially in bringing the average number of specifications for each commodity up to more than four. Most sand and gravel producers manufacture sizes and gradings of material slightly different from those of his neighbor. The different classes of material produced seem almost to have been chosen haphazardly.

The responsibility for this rather unsatisfactory state of affairs rests chiefly with the specification writer. Until very recently each engineer who used sand and gravel seemed to feel called upon to write his own specification, and these were generally not written with material produced locally in mind, but rather to conform to his ideas—sometimes good and sometimes not—of each engineer on what would best suit his needs. This resulted in almost as many specifications as engineers and the sand and gravel producer did his best to furnish materials to meet them. The engineer should not be blamed too severely, however, for his apparent inconsistencies; they were caused by lack of information on what constituted suitable material.

During the past several years much good work has been done toward the standardization of specifications for sand and gravel and similar materials; notably by the American Society for Testing Materials, the American Concrete Institute, various State Highway and City Engineering Departments and our own Washed Gravel Ballast Committee. Specifications proposed by such bodies as these tend to promote the manufacture of standard sizes of sand and gravel. That a great deal more work along these lines is needed cannot be doubted. The exact details of this work, just how far it should go and where it should stop, must be worked out carefully, in order that its consummation will be for the ultimate economy to the public as a whole.

*Director, Engineering and Research Division, National Sand and Gravel Association.

Standard Sizes

The term "size" is often used loosely to refer to the grading or classification of sand and gravel more definitely than to its actual dimensions. For example, material for reinforced concrete work is often referred to as 1-in. gravel, and means aggregate graded from 1 or 1¼ in. down to perhaps ¾-in., ⅝-in., ½-in., or whatever may be the local custom. In this paper "size" refers to screen or sieve sizes used for separation at the plant and for specifications of grading. It is not at once obvious why one producer should make one of the top sizes of his gravel 1-in. while another producer, perhaps, in the same town, has 1¼-in. for his top size. No good reason is at once apparent why Committee C-9 on Concrete and Concrete Aggregates of the American Society for Testing Materials should base their recommendations for sieve analyses of aggregates on the square mesh sieves shown in Table 1, while Committee D-4 of the same Society should recommend slightly different square mesh sieves for fine material and screens with circular openings for coarse material.

Sieves for Analyses

Sieves recommended by Committee C-9 of the American Society for Testing Materials in "Standard Method of Test for Sieve Analysis of Aggregates for Concrete:

TABLE 1

Sieve No. ¹ or size	Sieve opening		Wire diameter.		Tolerance, per cent.		
	in inches	mm.	mm.	in.	Average opening	Under	Maximum Over opening
No. 100	0.149	0.0059	0.102	0.0040	6	15	35 40
No. 50	0.297	0.0117	0.188	0.0074	6	15	35 40
No. 30	0.59	0.0232	0.33	0.0130	5	15	30 25
No. 16	1.19	0.0469	0.54	0.0213	3	15	30 10
No. 8	2.38	0.0937	0.84	0.0331	3	15	30 10
No. 4	4.76	0.187	1.27	0.050	3	15	30 10
3/8-in.	9.5	0.375	2.33	0.092	3	10	10 10
3/4-in.	19.0	0.75	3.42	0.135	3	10	10 10
1-in.	25.4	1.00	4.12	0.162	3	10	10 10
1½-in.	38.0	1.50	4.50	0.177	3	10	10 10
2-in.	50.8	2.00	4.88	0.192	3	10	10 10
3-in.	76.0	3.00	6.3	0.25	3	10	10 10

¹The requirements for sieves No. 100 to No. 4 conform to the requirements of the U. S. Standard Sieve Series as given in U. S. Bureau of Standards Letter Circular No. 74. The liberal tolerances will permit the use of certain sieves which do not exactly correspond to the numbers given in the table.

Standardization of these features is undoubtedly desirable. There seems to be no economic or technical reason why there should not be uniformity in this respect. Time will bring it about, but Time will be greatly aided in its work if the members of the National Sand and Gravel Association will lend their help.

For specification purposes the square mesh sieves suggested by Committee C-9 of the A. S. T. M. and adopted by the Joint Committee on Concrete and Reinforced Concrete is recommended for consideration. (See Table 1.) While it might be difficult to point out in what way this set of sieves is greatly better than others recommended by equally competent agencies, it does represent a standard, and probably the one which has been most generally adopted throughout the country. These sieves, at least

those finer than 3/8-in., were suggested by the U. S. Bureau of Standards after a careful study of the subject. They have the advantage of a logical and systematic arrangement of sizes. A study of the table will show that, except for the 1 and 2 in. sieves, the clear opening of each sieve is double that of the next smaller one. Another reason for the use of these sieves is that they facilitate the computation of the fineness modulus, which will be discussed briefly further on in this paper.

The selection of standard sieves or screen sizes for use in the manufacture of the product and the "bin sizes" which each manufacturer should produce is a part of the same problem. All manufacturers cannot, obviously, produce all sizes, but those which he does produce should conform as nearly as possible to some accepted standard. Perhaps the recommendations of the Joint Committee on Concrete and Reinforced Concrete for size and grading of coarse aggregate, which will be discussed below will serve as a basis for constructive thought along these lines (see Table 3).

Standardization of Grading

The standardization of grading of sand and gravel does not permit of as ready a solution as that of sizes. This should, in general, be an independent problem in each locality. It should have no other basis than a thorough study of the sand and gravel produced in the respective localities. To specify gradings which would necessitate wasting too large a proportion of the natural deposit would be economically unsound. What constitutes "too large a proportion" can be determined only from a careful study of the grading of the material and the effect of variations in the grading on the quality of the work in which it is to be used.

Such a study will be greatly facilitated by the standardization of manufactured sizes of sand and gravel. An example of the confusion caused by the lack of uniformity in manufactured sizes in one locality was experienced recently during the preparation of specifications for aggregate for a large public works to be erected in a prominent city. The engineer in charge of writing the specifications collected and tested many samples of sand and gravel from work under way, in an effort to obtain information which would enable him to prepare an intelligent specification for grading which could be met economically by the established producers in that locality. The manufactured product which he sampled varied over such a wide range, particularly in the case of the coarse aggregate, that it was only with extreme difficulty that a satisfactory specification was evolved.

A convenient form of specification for grading of sand is that recommended for fine aggregate for concrete by the Joint Committee (see Table 2). The percentages in the table are not a part of the specification but it is recommended by the Committee that they be used wherever practicable.

TABLE 2—GRADING OF FINE AGGREGATE	
Passing through No. 4 sieve	not less than 85 per cent by weight
Passing through No. 50 sieve	not more than 30 per cent by weight
	and not less than 10 per cent by weight
Weight removed by decantation	not more than 3 per cent by weight

Table 3 gives sizes and gradings of coarse aggregate recommended by the Joint Committee which should furnish a convenient form for specifications and offer some suggestions for selection of standard sizes.

Selection of Grading

A brief discussion of methods of selecting the most economical grading of aggregates for concrete should be of interest at this time. In the field of concrete, where, of course, the great amount of our material is used, researches carried out in the past few years have provided definite

TABLE 3—SIZE AND GRADING OF COARSE AGGREGATE

Nominal maximum size of aggregate, in.	Percentage by weight passing through standard sieves with square openings						Percentage passing, not more than	
	3 in.	2 in.	1½ in.	1 in.	¾ in.	½ in.	No. 4 sieve	No. 8 sieve
3	95	—	40-75	—	—	—	10	5
2	—	95	—	40-75	—	—	10	5
1½	—	—	95	—	40-75	—	10	5
1	—	—	—	95	—	—	10	5
¾	—	—	—	—	95	—	10	5
½	—	—	—	—	—	95	10	5

information which furnish a basis for the selection of proportions. Professor D. A. Abrams has conducted at the Structural Materials Research Laboratory what is undoubtedly the most comprehensive series of investigations which have ever been carried out on concrete aggregates. The results of his investigations, which have been confirmed in all of their essential features in many other laboratories, have furnished us with two extremely valuable tools to assist us in the intelligent use of our material—sand and gravel.

These are the "water-ratio" method of proportioning concrete and the "fineness modulus" method of measuring the grading of aggregate. Time permits of only a most limited discussion of these factors.

Water-Ratio

The water-ratio method of proportioning concrete* has for its basis the fact that the strength of concrete is fixed by the quantity of mixing water expressed as a ratio to the quantity of cement. So long as the concrete is workable and the aggregates are clean and structurally sound, the quantity of cement, the consistency or plasticity of the concrete, and the grading of the aggregate affect the strength of the concrete only insofar as they affect the quantity of mixing water required. The general recognition of this fact will be the greatest boon to the established sand and gravel industry that has ever occurred, as will be demonstrated, it is hoped, in what follows.

Since the essential factor in concrete, so far as the strength and similar features are concerned, is the water-ratio, it follows that it is this factor which should be most definitely specified, instead of the proportions of cement, sand and gravel. Provisions for limiting the quantity of mixing water occupies a prominent place in all modern specifications. Still more definite limitations are desirable and in at least one specification (proposed by F. R. McMillan and myself in a paper before the American Society of Civil Engineers in October of last year) the water-ratio, expressed as gallons of water per sack of cement, was the only factor of the proportions which was specified. This specification was successfully put into practice on a reinforced concrete job in Chicago.

Dependable Materials Needed

Such a specification at once places a premium on uniform well graded sand and gravel aggregates and points out their advantages more forcibly than has ever before been the case. The contractor at once learns that it is not feasible to operate under such a specification unless he receives materials, the uniformity of grading of which can be depended upon. Immediately fluctuations in the grading occur, the workability of the concrete varies over such a wide range that the proportions must be changed. Such changes not only hopelessly interfere with the routine of the job, but also make the question of costs of materials so uncertain that intelligent bids can not be made. Therefore dependable, uniform materials are essential, and can be obtained only from established producers.

Under this form of specification, well graded materials

*A comprehensive discussion of this subject was given in "Water-Ratio Specification for Concrete," by McMillan and Walker, presented before the American Society of Civil Engineers at Montreal in October, 1925. This paper will probably be published in the near future in the Proc. of the A. S. C. E.

will be insisted upon as never before. The better graded the aggregate the less cement will be required for a given water-ratio and condition of workability, and economy will demand the use of the best graded material available.

The water-ratio method of proportioning concrete, therefore, offers a ready means of determining what proportions of sand and gravel will be most economical.

Fineness Modulus

The fineness modulus method of measuring the grading of aggregate is a most useful corollary to the water-ratio method of proportioning concrete.

The fineness modulus is the sum of the percentages in the sieve analysis divided by 100, when the sieve analysis is expressed as percentages coarser than the sieves in Table 1, except the 1 and 2 in. sieves. For a complete discussion of this factor see Bulletin 1 of the Structural Materials Research Laboratory, "Design of Concrete Mixtures," by Duff A. Abrams.

Coarsely graded aggregates are indicated by a high fineness modulus, fine, poorly graded aggregates by a low fineness modulus. Within the limits of workability the quantity of mixing water required for concrete decreases, and hence the strength increases, as the fineness modulus increases.

Professor Abrams points out that for the range of conditions in which we are principally interested the quantity of mixing water in concrete is governed by the fineness modulus, and that therefore differently graded aggregates

which have the same fineness modulus have equal concrete making properties. This factor becomes, therefore, a most valuable tool in comparing the relative merits of different gradings of aggregate, and has great possibilities as a basis for specifications.

Other Measures of Grading

The surface area, the surface modulus, voids, and fixed sieve analysis (Fuller's curve for example) have been proposed as measures of the grading of aggregate. All of these methods possess merit. However none of them permit of as simple application as the fineness modulus, nor have the relations been worked out so completely. A discussion of them is, therefore, omitted from this paper.

This discussion may be summarized by the following:

1. The National Sand and Gravel Association should promote the use of standard sieve sizes in specifications for grading of aggregate and in the manufacturing process and should form a committee for the purpose of studying this problem.

2. The selection of the best grading of sand and gravel is, in general, a local economic problem, and should be done only after a careful study of materials marketed by the established producers.

3. The water-ratio method of proportioning concrete and the fineness modulus method of measuring the grading of the aggregate are most valuable tools which may be used to advantage in the selection of the most economical grading of sand and gravel to be specified.

How "Steve" Shearman Made His Millions

By JUDGE R. P. WILLIAMS

When A. N. "Steve" Shearman told us, at the Concrete Products Association convention, that he had just disposed of his southeastern pipe plants for \$2,000,000, we scented a story. Since he was too modest to tell it to us himself, we finally called upon his old friend, Judge Williams, of the Municipal Court of Knoxville, Tenn., to supply the sidelights that we thought our readers would enjoy. The judge's own version proved so refreshing and interesting that we are passing it along just as it was written.—The Editors.

"Large oaks from little acorns grow," is an old saying, but one that is true of the Shearman Concrete and Tile Company of Knoxville, Tenn., owned by A. N. Shearman, which recently sold for \$2,000,000. How did Shearman win? By hard work and giving to his customers pipe that would stand the test. His life was not a flowery bed of ease. Almost alone he made the fight that made his plants known all over the country.

Well do I remember when, back in 1904, while I was a reporter on the *Knoxville Sentinel*, I met Shearman, who was a delegate to the Democratic State Convention, and we became good friends. During that time the counties were building water-bound macadam roads, and the cities had started paving their streets with asphalt and other mod-

ern paving materials. I had been elected a member of the county court of Knox county, and while also working on a progressive paper, was advocating good roads and streets. Going over the roads, and writing stories about the paving, I soon learned a fact that many officials have taken years to learn: that drainage is the life of the road.

After weeks of campaigning for better roads, I dropped into the lobby of the old Hotel Imperial, now the Farragut hotel, to see what I could pick up for early copy. There I met my friend, Steve Shearman. In our conversation we naturally drifted into talk of roads and street improvements. I told him what I thought of such things, not dreaming that he was manufacturing a concrete pipe that would afterwards become famous. He said:

"For three years I have been quietly manufacturing a concrete pipe in Athens." He owned a hardware store, farm and a country newspaper in the little town of Athens,

The Little Rock and Dallas plants of the Shearman Concrete Pipe Company, formerly owned by A. N. Shearman, have been recently sold to R. S. Lander, secretary-treasurer of the firm, for a reported consideration of \$1,000,000. This follows the sale of the company's plants east of the Mississippi for a sum reported to have amounted to \$2,000,000.

about sixty miles from Knoxville. Shearman went on: "I have made a test of this pipe for three years, and it has stood the test. I am of the opinion that I should take some steps to put it on the market."

The First Advertising

He said to me: "Can you come down to Athens Sunday and let me show you what I have, and then, if you will, I want you to write a story about what you see and run it in your paper each day for a week, and I will pay the regular advertising rate for the space used, and the word 'advertisement' can be printed beneath the story."

I agreed, and Sunday afternoon he met me at the station at Athens. We first inspected his plant. It was a little shed and contained small equipment for mixing the concrete, a car load of chats from Mascot, and cement and other materials. From there we went out into the country where the pipe had been placed under the dirt roads. It had stood the test only a few inches underground. On the same road was the tile, the corrugated iron, which wagons had broken or bent so that the drainage was stopped. I was convinced that concrete pipe was the kind to put down, unless one wanted to replace it every few years. I gathered what data I desired, returned to my home Sunday night, and wrote my first story on concrete pipe, and why Shearman's Concrete Pipe was the best. For six days I had a different story on the use of concrete pipe.

Planning to Move

Mr. Shearman came to Knoxville soon afterwards and stated that he had received inquiries about concrete pipe. He asked me to write six more stories along the same line. In the stories I suggested that this plant would probably locate in Knoxville. In discussing this possibility I pointed out that the chat used was made only twelve miles east of Knoxville, and that a switch engine would bring him as many cars a day as needed, and at a much cheaper rate than he could get it in Athens. This little campaign started the ball to rolling. The large firms which made the galvanized iron pipe, and the manufacturers of the tile pipe, began to enter the fight and flood the city with various advertisements.

In 1916 Mr. Shearman met me on the street with this announcement: "Well, I have decided to locate a plant in Knoxville. All I want is assistance in finding a place to locate it. I am not selling any stock or asking any favors other than the good will of the people if the product merits it."

I went with him to the Chamber of Commerce, told the secretary what he was after, and the secretary replied that he would look into it. I called again, and the secretary said he did not believe there was much in the proposition, and passed it up. But Shearman had faith in his project, and went out and purchased the ground for his plant.

It so happened that the city engineer was tied up with a tile company, and it looked as if the county was lined up with the Metal Pipe Company, but this did not stop "Honest Steve" Shearman. Time and time again he said to me: "If I can only get the powers that be to see the real merit of the concrete pipe, it will win; the day is coming when only concrete pipe will be used wherever there is heavy travel. You will see the railroads placing it under their tracks. Then the county and city officials will realize its worth."

Getting on the Map

Shearman, in his modest way, attended all the big lettings over the country and, without any fuss or flurry, in a simple way presented the merits of his pipe. In fact, he succeeded in establishing a market for it outside of the state long before Knoxville and Knox county adopted it.

During the war he operated his plant day and night, and shipped not car loads, but train loads, of pipe. At one time he sent a large shipment for government use where there was a pressing need of pipe for permanent drainage.

The demand for concrete pipe grew to such an extent that his business spread over the south and it became necessary to increase his plant. Being a business man, he figured on freight rates, and ended by building other plants in different states, the first in Little Rock, Ark., and ten others in the following cities: Norfolk, Va., Atlanta, Ga., Jacksonville, Lakeworth, Bonbow, Manatee, Clearwater and Tampa, Fla., Dallas, Texas, and Montgomery, Ala.

Shearman's slogan in business was, "The customer satisfied," and he carried his slogan out to the letter. In his biddings he would make this provision: "If the pipe is not what I recommend it to be, it will not cost you one penny."

He has recently sold his holdings in the plants in the southeast, but it is quite likely we will hear of him again in active business in the far west, or on the Pacific slope.

Shearman's Concrete Pipe was made by a man who believes in honesty in business; also that merchandise should never be sold just for the sake of a sale, but that the purchaser should be so satisfied with his buy that he will become a customer for life.

Standard Bar Contract Form Taking Hold

In the last issue the standard order form adopted by the Concrete Reinforcing Steel Institute was described. Since that issue went to press we have heard from most of the distributors who are members of that Institute and find that the distributors are for the most part now either using the form, about to put it to use, or are thinking seriously of adopting the form. The one outstanding exception is the group of distributors located in California and other states bordering on the Pacific. These vendors, some twelve in number, are mostly sub-contractors as well, and have formed a local institute of their own. Because of the local situation this unit of the industry is giving the matter separate consideration, and may eventually adopt some such plan in a modified state.

A majority of the distributors are now using the forms, according to information that they have given us, or plan to do so within the very near future. A couple of others are putting it to use as soon as it is feasible, but not immediately, one of them now using a form that is almost the same. Another firm has modified it slightly to conform to certain statutes operative in their own state.

In other words, the standard form adopted by the industry will soon be applied as nearly as possible by the individual members of the association.

Those writing to this journal about the change, have inferred that the contract form has been well received by most buyers, but that quite a few of the larger construction firms have their own standard forms and rather hesitate to sign something that is not so well designed, as some of their own are, to protect their own interests. This, however, is a situation that the bar distributors are hopeful of solving. The main argument against the use of the contractors' own forms is that they frequently contain many clauses that are inapplicable to a certain material and that these clauses have to be carefully weeded out each time before the contract may be considered safe. The standard form not only obviates this situation, but simplifies estimating to a considerable degree. The form adopted by the distributor appears to be perfectly fair for the contractor as well as for the distributor, and contains no clauses that need be feared by the honest purchaser.

Making Precast Sidewalk Slabs

Not all sidewalks are made of concrete that is mixed and placed on the job. In the Twin Cities, as in England, many concrete sidewalks are built of slabs that are made in the factory and merely laid as tile. It is not only being done, in St. Paul and in Minneapolis, but it is being done to the satisfaction of the property owner and to the profit of the manufacturer. According to H. C. Berchem, manager of the St. Paul Cement Works, where these sidewalk tile are manufactured, a special mold is needed to make slabs.

This equipment consists of a cast iron mold, 24 in. by 24 in., or 18 in. by 18 in., according to the size slab desired, and 4 in. deep. A supply of pallets, two inches thick, are needed. The mold is fastened to a wooden table or bench, under which is a lever connected to four wooden rods or pegs, which extend through the bench and carry the pallets.

To make a slab, the pallet is placed in the mold, and the mold is then filled with a plastic mixed concrete, proportioned 1:4 to the depth of $1\frac{1}{2}$ in. The remaining $\frac{1}{2}$ in. is then filled with the 1:2 facing materials, to which is some-

times added a mineral color. This finish layer is given a rough trowel finish or a smooth trowel finish, depending upon the use to which the slab is to be put. The rough surface is the best for the sidewalks, as it will not be slippery in wet weather, while the smoother finishes are called for when the slabs are to be used in garage floors. When the slab has been tamped and trowelled, the operator steps on the lever which raises the work and the pallet out of the mold. The slabs are then carried to racks, where they remain for three days, and they are then removed to the storage yard to gain further strength. Here the units are stood up on edge and remain until strong enough to be used.

In St. Paul the 24 in. by 24 in. by 2 in. slabs are delivered to the work in truckload lots for 9 cents a square foot, or 36 cents per tile. The average price for laying tile on a 2 in. bed of screened sand is from 6 cents to 9 cents per square foot, making the completed cost from 15 cents to 18 cents per square foot. The cost of laying will vary with the conditions encountered on the work, and will depend upon the amount of work needed to prepare the sub-grade



General view of the gravel pit, plant, and yard, showing a good stock of block and other products waiting delivery. A truckload of sidewalk slabs is ready for delivery. Belt conveyors take the aggregates to the plant, while roller conveyors transport the products to the storage yard



Another view of the plant, with a truck being loaded with block for another concrete masonry residence. A good stock of slabs are to be seen on the right. Notice the way this producer stacks his products in the yard

or to carry the materials, as well as upon the efficiency of the organization on the job.

When the tile, or slabs, are laid on the sand cushion, the joints are slushed with a grout of cement and water. This is mixed to a thin consistency and is swept into the joints with a brush. The last step in the laying is taken as soon as the tile are dry, but the joints still damp. Dry cement is swept over the work and into the joints, and the job is completed.

Some years ago the same concern made slabs of hexagonal shape, but since these proved more expensive to lay they were abandoned in favor of the rectangular units. The St. Paul Cement Works also produces concrete block, trim stone, bird baths and burial vaults, with which they have worked up an enviable reputation. The sidewalk slabs are not only used in the construction of sidewalks, but they are utilized for porch floors, private garage floors, and for many other similar types of work.

British Engineer Announces New Idea in Design

By A. C. BLACKALL
London, England

An interesting new system of reinforced concrete construction and its application to silt and running sand soil conditions was recently described before the Yorkshire branch of the British Institute of Structural Engineers by D. Davidson. Mr. Davidson claimed that in this system there are no beams and no shear reinforcement, the maximum of flexural resistance with the minimum of steel reinforcement, and the minimum of bearing area of supports.

These factors are attained by the application of the principle that the stress transmission route of all load increments should be directly along the shortest line from the point of load application on the floor to the supports of the floor. In the comparative type of ordinary construction the load increments are conveyed from a floor panel point across the floor panel to the panel beam, are then conveyed along the cross-beams to the main beams, and finally along the main beams to the supports. Consequently, the panel beams, cross-beams, and the main beams have all to be cumulatively strengthened as the load transmission route is lengthened, the result being increased weight and increased cost in steel and concrete.

Mr. Davidson claimed that this new system has a very economical application in the case of wide-span floors for factories, warehouses, hospitals and similar large structures. For heavy floor foundations, for engineering and architectural works, to be carried by poor-bearing strata of a semi-liquid and plastic nature, or of the nature of running sand, the system is markedly efficient and economical. When to these conditions of construction and foundation strata is added the problem of alternations of upward and downward pressure, actual experience has proved that an economy of at least 50 per cent is effected by the application of the new system. The application of the system to the floors and foundations of the new sewage settlement tanks at the low-level sewage disposal works of the municipal corporation of the city of Leeds showed that the saving on ordinary methods of construction amounted to 53½ per cent. The most economical of the ordinary methods of construction gave a cost of £215,000 (approximately \$1,075,000), whereas the new system gave a cost of less than £100,000 (approximately \$500,000), thus representing a saving of over \$575,000.

The American Engineering Company of Philadelphia, announce the appointment of H. Kempner as sales manager of its "Lo-Hed" electric hoist division.

Co-operative Education To Be Checked Up in Meeting

An association recently formed by American colleges and universities giving co-operative instruction in engineering, commerce, architecture and other subjects will hold its first annual meeting June 14 and 15 at the University of Cincinnati, where the co-operative system was originated by Dean Herman Schneider twenty years ago.

Under the co-operative plan the students spend alternate periods at the university and at work in industry. While one student is in school his alternate is receiving practical training in some factory or office, and vice versa. In this way both the school and the shop are always fully manned. The theory learned in the classroom is thus applied in industry, and the problems which arise in industry are brought to the classroom.

Co-operative courses have been established in many colleges, both in the United States and in foreign countries. Among the American institutions now offering such courses are the Municipal University of Akron, Ohio; Antioch College, Yellow Springs, Ohio; the University of Detroit; Drexel Institute, Philadelphia; the Georgia School of Technology, Atlanta; the University of Louisville; Marquette University, Milwaukee; the Massachusetts Institute of Technology; the Newark Technical School, Newark, N. J.; the University of North Carolina; Northeastern University, Boston; University of Pittsburgh; Southern Methodist University, Dallas, Texas; University of Texas, and the University of Cincinnati. Representatives from most of these will attend the meeting in Cincinnati in June.

Practically all types of manufacturing and construction enterprises have been used successfully in the training of co-operative students during their outside work period. Transportation and commercial organizations have proved equally useful for the same purpose, and, more recently, co-operative relations have been established between the colleges and those industries in which art is a factor.

The students profit by an opportunity to study technical problems at first hand and by access to the best modern equipment. The firms have the benefit of the enthusiasm and the analytical point of view brought into their organizations by student employees, who are frequently able to contribute more than the satisfactory completion of the day's work.

Some well-known firms employing co-operative students are the American Steel and Wire Company, the American Rolling Mill Company, the Baldwin Locomotive Works, the Ferro Concrete Company, the Ford Motor Company, the General Electric Company, the New York Central Railway Company, the Pennsylvania Railroad Company, the White Motor Company and the Worthington Pump and Machinery Corporation.

At the coming session at Cincinnati a program will be presented dealing with various phases of educational work in college and industry and with the co-operation between the two. The principal subject for discussion will be that of methods for bringing about closer and more effective co-operation between the college and the employing firms. Details of operation and administration will be considered, such as the best period of alternation, the use of syllabi and work reports, and the utilization of industrial problems in the classroom.

In one evening, last March, the State Highway Department of Tennessee broke all state records by awarding contracts for approximately 180 miles of highway. The total cost will be about \$3,000,000. These awards include a substantial mileage of concrete pavement and a number of bridges and culverts.

More Facts About Color in Concrete

Colored Concrete and Portland Cement Stucco Is Proving Popular—How to Select Pigments—Unusual Effects Obtained with Selected Aggregates.

By K. A. HATT

So many have been the inquiries since the last article was published in CONCRETE on the use of color that a few further facts have been gathered for the benefit of the readers. Color, as has been said before, may be gained by the use of pigments, by means of colored aggregates, and by the use of both at once. The possibilities, especially when textures, too, are called upon to aid in the general effect, are endless. An active imagination, plus good taste, plus an idea of architectural fitness and tradition, need be the only limiting factors. Since every builder and every architect will desire to evolve his own color schemes, and not follow blindly the few settled effects that have already been given publication, it is only within the province of this article to present a ready guide in the selection of colors and aggregates for use, with particular attention given to quality, and to give a summary of the few general rules of manipulation that should be followed if the best workmanship is to be obtained.

The first and primary rule is that the best of colors are required. From the outset this means expense—but the cost is worth while, since the cheaper colors will fade in a short time, or may be so coarsely ground as to require the use of too great a quantity to secure the desired tint, or they may even be of such a nature as to somewhat reduce the strength of the concrete. Price, after all, is some indication of quality, but not an infallible one. Naturally there is a separate range of prices for each color, depending upon the cost of production. Reds generally cost the least, blacks slightly higher, yellows, browns, buffs and purples cost a little more, while blues and greens cost from two to three times as much as the reds.

A Guide to Quality

A true guide to quality, however, can be based upon nothing but tests, and upon the reputation of the manufacturer. There are several tests that may be applied to any pigment to reveal its worth for use with stucco and other concrete work. Fineness is an important consideration. To be effective and economical a pigment must be at least as fine as the cement. This means that at least 78 per cent must be able to pass a sieve having 200 meshes to the lineal inch.

To test a pigment for a tendency to cause efflorescence, a paste is made with distilled water—procurable at any battery shop, filling station or drug store. A pat of this paste is left to dry on a piece of clean glass. After the water has evaporated, efflorescence will appear at the edges of the pat if the color is of an inferior quality. To test the color for the effect upon it of lime—the main alkali of cement—make two pats, one with hydrated lime and one without, and let stand for a time. Then compare the two for any difference in shade and tone.

Sunlight has been known to show up the quality of many a pigment. Only those that can withstand the sun's rays are acceptable. Unless a special light for the purpose is available, this test will take time. Spread a layer of the pigment over a slip of paper on which a layer of gelatine

has been applied. Put half of this in a photographic frame and expose it to the sunlight, while the other half is kept in the dark. Any bleaching will be easily observed by comparing the two at a future date.

A Quicker Test

A quicker test, advised by a stucco manufacturer, is to drop some of the pigment into a bottle containing a solution of muriatic acid. If the color is inferior it will be quickly turned to a chalky white, while the permanent pigment will come through unscathed. Whether the color is organic or mineral can be readily determined by heating it upon a sheet of platinum over a hot flame. Mineral colors should not be affected, except for a change in tone or, even, in some cases, a change of color. Organic colors, the sort unsuitable for work in connection with concrete, are volatile and will be vaporized by the heat.

A prominent research laboratory is now investigating the suitability of various pigments for the work and should soon place the selection of colors on a more scientific basis, and perhaps evolve simpler tests that can be even more readily applied on the job by the contractor.

The importance of fineness cannot be stressed too greatly. Tinting power, it has been shown, depends upon fineness. The finer the pigment the farther it will go. Pigment of the right sort, being an inert material of a fineness equal to or greater than that of the cement, will prove deleterious if used in excess quantity. The maximum that should be permitted is about ten per cent by weight of cement. None but the finer pigments of high tinting power will give many of the stronger tints when such a limited quantity is used. Structural considerations, together with true economy, therefore dictate the use of the finer, and therefore the more expensive pigments.

Organic Colors

The consideration of the use of mineral colors instead of organic colors is based upon two factors. The first factor is known to all who handle concrete work of any kind. It is an acknowledged fact that organic material in even small proportions is highly injurious to concrete. It reduces the strength, when a large amount of organic material is used, to a dangerous degree. (A 3 per cent solution of sodium hydroxide is often used to reveal the presence of organic material.) It is therefore important that only mineral pigments be used. The other reason why only the latter type of pigments are suitable is that organic pigments are, in time, leached out by the rain or decomposed by the sun's rays, and the color cannot be relied upon to be permanent. Some organic pigments are decomposed by the alkaline elements in the cement, or by the lime admixture that may be used.

In selecting colors, a good manufacturer should be consulted who is capable of advising on individual needs. He will be glad to submit samples of the pigments that he suggests, and give quotations on the various grades. Part of the pigment from each sample may be used in making some of the simple tests described above and the quantities

needed to give the desired results may then be worked out in terms of a regular formula that can be adhered to strictly on the job.

When the materials arrive, a number of test pats should be made with the color, the cement, the sand, and the consistency required, each made with a determined percentage of color, and the samples dried. It is then a simple matter to compare tints and select the one to be used. If the proportions selected are adhered to, the required color effect will then be readily obtained on the job.

Mixing Cement and Color

The use of color calls for care in executing the work. In order that the color distribution in the concrete may be uniform the coloring material must be thoroughly mixed with the concrete. The best practice, to begin with, is to grind the cement and the dry color together in a small ball mill until the two are intimately mixed. The cement, color and aggregates are then put into the mixer and mixed dry for several minutes before the water is added. This is considered far more effective than adding the color to the gauging water.

For colored stucco on a concrete masonry wall, whether monolithic or block, it should be made certain to begin with, that the suction of the backing is uniform. When any type of masonry is to be stuccoed it will be necessary to exercise still greater caution in the selection of material, since greater variations in suction are to be expected. Different types of masonry materials should not be mixed up in the same wall. Variations in suction will cause a variable withdrawal of moisture from the stucco and lead to a splotchy appearance of the finished surface. When stuccoing a frame building no wood lath should be used. The only satisfactory lath for cement stucco is the metal variety—either the wire mesh or the expanded metal. This should be well furred out and completely embedded so that it will never rust out.

Special Aggregates

The use of pigments to gain color in concrete is not the universal method, although it is a means that is widely used. There is another way to obtain color, and the second method opens a way to color treatment that offers a truly infinite variety of effects, ranging from those that truly duplicate the appearance of quarried stone to others that rival the most famous mosaics of the ancients. In between are effects that are typical of nothing else but which express the material concrete itself.

This second way to provide color is by the use of selected aggregates, either as part of the entire concrete mass, as a special facing layer, or as a pebble dash pressed into the surface while the concrete is yet soft.

Just as with mineral pigments, this latter mode of expression is equally adaptable to mass concrete, stucco, and precast units, except that the old fashioned pebble dash, naturally can only be used in connection with a plastic surface layer of the nature of stucco, but this stucco can be applied just as well to a monolithic concrete surface as to concrete masonry.

Pebble dash is applied after the finish coat or finish layer has been brought to a smooth, even surface and before it has appreciably hardened. Clean, round pebbles, or other selected facing aggregated, preferably not smaller than $\frac{1}{4}$ -in. nor larger than $\frac{3}{4}$ -in., and previously wetted, are thrown forcibly against the surface so as to be embedded in the fresh mortar. The dash is then distributed uniformly over the surface with a clean wood float, but once the pebbles are well embedded, no rubbing should be done. They should be well pressed into the surface.

Machines have been perfected that will do this work at a great saving of labor. One device is constructed to throw the pebbles with such force that a dash finish should now be possible on block that have just been taken from the machine.

Exposed Aggregates

When the special facing aggregates are used as part of the mix, the mortar of the finish coat is made up of coarse sand, portland cement, and selected crushed marble, granite or other coarse aggregates, in the proportions and colors required to give the desired color effect. Within 24 hours after application, the surface is scrubbed with a stiff wire brush and water to expose the aggregates that are up to this point covered with a dull film of cement and sand. In case the mortar has become too well hardened it is necessary to use a solution of one part muriatic (commercial hydrochloric) acid in four parts of water, by volume—a quart of acid to a gallon of water—and the acid thoroughly washed off with clear water as soon as the colored aggregates have been uniformly exposed.

Two of the most pleasing surface effects can be made with a combination of white marble chips with a sprinkling of black marble or green-black copper slag, or with buff pigment, graded marble chips and a sprinkling of mica spar. Many other combinations have been worked out by products makers and contractors who have gone in for this class of work. Concrete products manufacturers have found use for such special aggregates as crushed marble, granite, colored sands, gravels and for a wide range of mineral pigments. Mica flakes are often used to create a sparkling effect, while still other effects are obtained from the use of crushed clam shells and oyster shells, in the natural state or artificially colored. Button-factory waste is purchased by a number of firms for this purpose. Crushed colored glass and crushed slag in the various colors afford still more variety. Mica spar, white quartz and white silica sand are very widely used. Where acid fumes are to be encountered, the choice of aggregates is somewhat restricted, since marble and limestone chips are in time disintegrated by such fumes.

Cut Cast Stone

While many producers of ornamental concrete block and cast stone utilize the special aggregates for surface ornamentation and simply cast the units to final dimension, relying upon the wash to expose the aggregates, others cast the stone "in the rough" and use stone-cutter's machinery and tools to dress the hardened concrete just as if it were quarried stone. This latter method has some advantages. One of them is that any crazing that is to take place has already been completed before the stone is cut, and that this crazed material is then removed in the cutting. This is of importance, since many of the desired effects are sometimes ruined by hair-checking of the surface of precast concrete. By means of mechanical dressing, cast stone can even be polished, just as is done with marbles and granites.

As mentioned above, the special aggregates may be used together with mineral colors to obtain many good effects.

In this connection it is of interest to note that gray cement and silty sands will spoil the tone of the more delicate colors. It is better, in these cases, to use one of the white Portland cements that are on the market, and to select the whiter sands. Then, too, the water supply must be of good quality. The maxim, water good enough to drink is good enough for concrete, has a particular

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Concrete Shown at French Exposition

By THEODORE WOLFRAM

The International Exposition of Water-Power and Touring at Grenoble, France, is now reported to be open after considerable delay. Concrete construction has its place at this exposition.

The principal building of the exposition is the "Grand Palace of Water-Power," a huge building forming the center of the ensemble. Constructed of armored cement, this structure is 105 meters long, 35 meters wide and 18 meters high. Attractively designed and resting on a high piece of ground, it forms an imposing spectacle with



Side view of the stucco "Palais du Tourism" at the exposition

numerous cascades tumbling down from the room into superposed basins overflowing into a huge concrete basin with a series of fountains launching jets of water high into the air.

Most of the other buildings are stucco or staff coated and are not particularly striking in design, with the exception of the "Palais de Tourism" which is quite "modern" although to me the side view suggests a Pueblo cliff-dwellers' village. A "Modern Home" built of concrete and finished in cream colored stucco was still in embryo at my last visit. One story high and quite square in form it gives little promise of being attractive. It is, however, quite a departure from the usual French type of home structure and should demonstrate the advantage and prac-



This observation tower at the Grenoble exposition called for the use of cement



The "Porte de France" cement company exhibit at Grenoble

ticability of the American "bungalow" idea.

Grenoble besides being a center of water power and touring is also a center of cement production. Although cement in various forms has been employed to a considerable extent in the construction of the Grenoble exposition, it seems to me that the cement producers have let slip an opportunity to promote new uses and augment already known uses of cement and concrete. The only cement producing firm of the region that has an exhibit of any importance at the exposition is the "Porte de France" company of Grenoble which has a novel and attractive stand combining ornamental and useful forms of cement construction.

A huge cylinder of concrete supported by two smaller pipes serves as a stand containing an exhibit of various ornamental cement articles and photographs illustrating various uses of cement and concrete. A handsome double stairway, flanked by an arch composed of two cement posts, such as are used for electric power lines, leads the visitor into this compact but interesting exhibit. Ornamental cement blocks, vases and urns filled with gayly colored blossoms strikingly present the various useful and ornamental uses to which cement can be put.

Another concrete structure of note at the exposition is a tall tower some eighty meters in height which serves as an observation point from which a magnificent view of the exposition, Grenoble, and the surrounding Alps, can be enjoyed. At night a huge searchlight lights up the surrounding peaks and the public buildings of Grenoble.

Water-power, electricity, transportation in its various forms are well represented and "touring" is out in full force. The exhibits in the various sections devoted to travel are very complete and include everything from a museum of transportation from its infancy up to the latest novelties in aviation, as well as a large section given over to all sorts of travel accessories ranging from food and medicaments to clothing and baggage. America's only official exhibit is a collection of photographs and panoramas illustrating the beauties of America.

Grenoble and its exposition are well worth a visit from a scenic viewpoint alone, and to anyone interested in water-power and electricity the exposition has much to offer and time can be spent to real advantage in the surrounding Alps where some of the largest hydraulic projects of France are in operation or under construction.

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meaning to the producer of cast stone. Of course the water must be free from iron oxide and other discoloring matter, since rust has stained many units and the stain cannot always be removed. Surface stains of this nature, however, can sometimes be removed by a wash of muriatic acid.

An Elementary Guide

The facts given above are of an elementary nature and give a general fund of information that will but serve as a rough guide to the contractor and the products manufacturer who are just beginning to take advantage of the opportunities inherent in concrete. More detailed information may be secured by those whose problems cannot be solved with the help given by this article. The methods that will permit the concretor to take complete advantage of the unusual properties of the material will be given in more detail from time to time in these pages. We look forward to the day when concrete in all its forms will carry its own architectural treatments, based upon form, color and texture.

Construction Shows Slight Recession in Month of April

The latest National Building Survey, published by S. W. Straus & Co., indicates that there has been a slight falling off of construction, as shown by the permits issued in 484 leading cities and towns. Total valuations for that month, according to the report, reached \$440,376,537, as compared with \$479,833,247 in April, 1925. This is a loss of about eight per cent. There was a slight gain from March, however, when the permits issued indicated construction projects worth \$433,852,219. It is impossible to say, at this time, intimates the report, whether or not this presages a real slump in construction, or whether there will be a real revival later in the year. No one in the industry, it is said, expects any great falling off of building.

Lumber Standards Work Makes Further Progress

Recommendations covering simplified trade practices benefiting consumers, producers and distributors of lumber were recently adopted in Washington, D. C., at the sixth general lumber conference held in the Department of Commerce.

More than 150 representatives of the national lumber industry, manufacturers, distributors, architects, engineers and other technical experts accepted recommendations dealing with suggested additions and amendments to the American lumber standards as submitted by the Central Committee on Lumber Standards. John H. Kirby of Houston, Texas, presided.

A more detailed technical study of the problem of the shipping weight and moisture content of lumber was voted after representatives of the engineers and railroads, the American Society of Mechanical Engineers, the architects and others had opposed a resolution by the central committee to the effect that it was not practicable or possible to guarantee any given moisture content or shipping weight at the point of shipment, at the point of delivery or at the point of consumption. This recommendation was amended and the matter referred to a sub-committee for further consideration.

A resolution of the Central Committee urging that everything possible be done to discourage the manufacture and sale of sub-standard lumber and to encourage the specifying and using of American standard lumber, was approved. Recommendations providing for several changes in the American standard widths of lumber, were also approved.

Adolph Pfund, secretary of the National Retail Lumber Dealers' Association, submitted an amendment dealing with short length lumber which was adopted and which provided that marketing practice covering lengths of yard lumber shall permit buyers to secure specified lengths or specified assortments of lengths.

The meeting is part of the simplified practice program of the Department of Commerce inaugurated by Secretary Hoover.

Concrete Tanker No. 1—otherwise known as the *McKittrick*—is one of the surviving war-time concrete vessels still on the job. This tanker, one of a series built for the government during the war, is still doing daily service in San Francisco Bay, in spite of the fact that many of the concrete ships built during the conflict have long since disappeared from the seas.

Detroit Material Firms Announce Large Merger

The United Fuel & Supply Company of Detroit, Michigan, has recently been completely reorganized and developed to greater strength. The executive personnel of the organization has been changed entirely.

It has acquired the old company of the same name. To this nucleus has been added the Superior Sand & Gravel Company, as well as certain assets of the Delta Brick & Tile Company, Superior Plaster Company, Birmingham Sand & Gravel Company, Detroit Steamship Company, and a controlling interest in the Huron Sand & Gravel Company.

As now constituted, this organization is the largest of its kind in Michigan, and one of the largest in the country.

The United Fuel & Supply Company not only will continue supplying builders' materials and fuels to Detroit and Michigan, but will also carry on the business of the Superior Sand & Gravel Company in manufacturing Superior Concrete Sewer Pipe, as well as digging and distributing sand and gravel. It will also take an active interest in the companies in which it is interested.

The new management is one of extensive experience in this work. James D. Kennedy, president of the United Fuel & Supply Company, was formerly president of the Superior Sand & Gravel Company. George H. Hutchins, vice-president and general manager, has been connected with building and building operations for a number of years. E. H. Bingham, vice president and manager, was general manager of the Superior Sand & Gravel Company.

The company owns and operates a fleet of seven steamships, supplemented by tugs and barges, and 300 motor trucks, cars and tractors. Its operations require the services of over 1000 employees.

New York Building Congress Holds Its Annual Meeting

At its annual meeting held in New York City during the last week in April, the New York Building Congress concluded its first five years' service to the building industry in that city. The event was marked by the retirement of Stephen F. Voorhees, of McKenzie, Voorhees & Gmelin, architects, as president, and the election of R. H. Shreve, of Shreve and Lamb, architects, as his successor. The remaining officers of the congress remained in office, with the exception of John Lowry, who succeeded A. J. Post as one of the three vice-presidents. The gathering of nearly 400 people, comprising financial, manufacturing, architecture, engineering, contracting, labor and other interests, heard the Hon. Julian A. Gregory, chairman of the Port Authority of New York, outline the problems of traffic and transportation affecting the metropolitan district. They were told how the area is to be districted for the receipt and transmission of freight and traffic dispatched by the shortest route from point to point, in order that the present confusion and wasted effort may be eliminated. This plan, when put into operation, should prove of benefit to the contractor who is having materials shipped to New York construction work.

Engineers to Unify Wire and Sheet Metal Gages

The elimination of the confusion caused by thirty wire and sheet metal gage systems now in use in this country is to be brought about as the result of a conference held recently in the Engineering Societies Building, New York

City, and attended by representatives of twenty-five organizations interested in all phases of the subject, which includes wires, sheets and tubes of metals of all kinds.

Unanimous decision was reached that the confusion in the purchase and sale, and in the use of these products, brought about by the existence side by side of the numerous conflicting gage systems, has become intolerable, and that industrial practice should be unified in a simple consistent plan. The detailed technical work will be in the hands of a sectional committee broadly representing all interested industrial groups and working under the auspices of the American Engineering Standards Committee.

The trend of opinion at the conference strongly favored the elimination of all gage numbers and the use of a simple system of designating sizes in decimals of an inch. The decision, however, on the exact form of the solution was left to the sectional committee.

Concrete Piles Driven 24 Hours After Casting

In some recent tests carried on by the engineers of the California Highway Department results were recorded which will prove of value in reinforced concrete pile foundation construction. In driving piles for bridge construction a concrete "test" pile was cast using Lumnite cement instead of ordinary portland cement. Twenty-four hours after the pile was cast it was driven 45 feet in the ground by a steam hammer. Six hundred forty-three blows of the steam hammer were required to sink the pile to that depth. It is claimed that Lumnite cement seems to have



Hoisting the concrete pile into place. The same pile finally driven, only one day after it had been cast

developed in twenty-four hours greater strength than portland cement would in twenty-eight days.

By using this cement a test concrete pile can be cast and driven on short notice so that exact construction conditions and requirements may be determined upon. Wooden test piles may be done away with as the only reason they have been used is to do away with waiting twenty-eight days for an ordinary concrete pile to cure. The use of a concrete test pile is a true guide for determining the proper length for other concrete piles.

Two hundred and forty reinforced concrete bridges will be constructed in Chile, according to a consular report. The Bureau of Public Works decided against steel since the reinforced concrete has greater durability and because costs could be lowered by the use of Chilean cement.

New Equipment

New Shears for Cutting Reinforcing Bars and Mesh

Among products recently introduced, of interest to contractors, is the Scoggins line of patented manual metal cutting shears. These shears are made in four models, or types, with varied capacities up to that of the largest, which is rated for cutting up to and including $\frac{7}{8}$ -in. round and square bar and $4 \times \frac{5}{8}$ -in. mild steel flat stock. The weight of this particular shear is only 90 pounds, the others being considerably less.

An interesting feature of these shears is the patented application of compounded leverage. Using the Type No. 3, which is illustrated, for an example, the shear is so arranged that various compounds may be used at the will of the operator, yet, in each event, the lever fulcrums are so located that a slight pressure exerted upon the handle is compounded many times before it is transferred to the jaw carrying the cutting blade. For example, one series of compounds is 6 ft. : $2\frac{1}{2}$ in. to 7 in. : $2\frac{1}{2}$ in. to 19 in. : $5\frac{1}{2}$ in. Each pair of levers are connected by links so that throughout the entire unit every part of the leverage system is in tension rather than compression, or torsion, thus making possible a much lighter sectional construction than would be possible with any other arrangement.

In addition to the method of applying the leverage, several other features of the shear have been patented. Its efficiency is attributed in a large measure to the method of hinging the upper jaw, so that, regardless of the strain, there is said to be no possibility of misalignment of the cutting blades. This feature assures a clean cut, without

burrs, up to the shears' capacity. Even if taxed beyond its rated capacity, the blades have no opportunity to spread.

Other interesting features are the method of setting the blades (which are easily removed for resharpening) in the jaws so that no strain comes on the bolts; a very substantial and adjustable stripper on the three larger sizes, and the easy method of adjusting for various leverages, and sizes of stock, through the medium of the notched fan. The lightness of weight is attained by the employment of electric steel castings throughout, with a frame member cross-section designed for ample strength yet with no excess of weight. The handle, on all types, pulls down directly above the cutting blades, assuring the operator complete visibility and accurate work.

These shears are portable; can be mounted anywhere; occupy little space, and are said to stand up under the severest duty. Additional information may be secured by addressing the Industrial Sales Corporation, 443 South San Pedro Street, Los Angeles, California.

Stuebing Perfects New Rack for Lift Trucks

The increased popularity of the lift truck system for handling concrete products on platforms and racks has brought forth some interesting developments. Several millions of various types of platforms are in use today. Many users have resorted to makeshift platform constructions because it appeared that no standard construction was available.

The original cost and maintenance of these racks represents the greatest drag on profits through their use in handling materials with lift trucks.

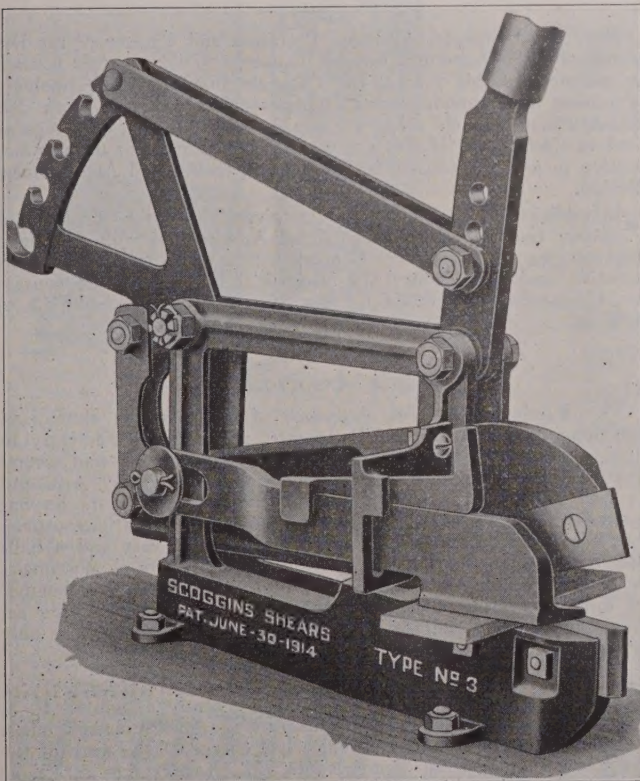
A new type of steel-bound platform has been perfected by Mr. W. R. Stuebing of the Stuebing Truck Company of Cincinnati, Ohio, and patents covering the construction and trademarks protecting the name have been granted. It has many distinctive features that should make it an economical platform unit, the principal feature of which is the method of clamping the wooden top between the jaws of the two steel angle rails, which gives a vise-like gripping action that results in rigidity and strength.

This construction also makes the platform as flexible to changing requirements as a sectional bookcase, permits the instant application or conversion into bin types for handling small parts, stake types for long material, rack and table types, or the use of crane hooks where the load is to be handled overhead during certain phases of production.

The design of this structure is said to enable these platforms to withstand punishment which would make kindling wood of ordinary types, and to carry with safety 10,000 and even 20,000 pound loads.

This Stuebing product is being made by the Stuebing-Cowan Company with main offices and plant at Cincinnati, Ohio, and the Cowan Truck Company plant at Holyoke, Massachusetts, the latter company having been recently acquired by the Stuebing Truck Company.

Last year a fellow tried to save money by leaving out the sand under the salamanders, but he found that patching a scorched floor was kind of expensive.



Here is type No. 3 of the new bar-cutting shears.

Mixer Musings

Reported by "Joe"—The Mixer Boss.

Somebody's Working to Lose His Job

My friend the editor was over to the shack today askin' for my monthly bit of fun an' filosofy, and I'd nothin' at all wrote down for your amusement, so we got to talkin' things over, and he told me this tale.

It seems that a certain party out in the suburbs heard that this town was goin' to pave the street, so he attended the hearin' to see about puttin' in concrete. The folks were all for it at first, till some guy got up an' reminded them that macadam was good for some twenty years, barrin' a bit of patchin' every spring and fall and in between, but who'd ever heard of a concrete street that was good for that long. Then he sort of mentioned a cost that was low for macadam and for black-top, and a price that was sky-high for concrete, and the dubs fell for it hard. It seems that the man who'd been putting in the concrete out that way had been skinnin' his jobs to a fare-you-well, so of course nobody out there had heard of real concrete pavin'. So the other stuff is goin' in, and the tax-payers won't wake up till too late.

But my idea is this:

That fellow who does concrete work out there may have made good money by skinnin' his previous jobs, but now he has less jobs to skin, and maybe soon won't have any. He'd ha' made more money in the end if he'd delivered the goods to begin with and not tried to hog it all the first time he was awarded a bunch of juicy jobs.

While your men are mixing concrete, why not try a little mixing at your coming conventions? You will find that it will pay handsome dividends if properly done.

The fellow who lost his chuting plant the other day 'cause he didn't have it guyed securely will be guyed about it the rest of the year. Nothing is so ignorant as the concrete contractor who knows all about it.

Many a good shipment of block has been crabbed by daylight showing through the joints. There are lots of bricklayers who would do better as makers of screens and corrugated plates.

A masonry wall is no stronger than its mortar joints, nor is a block any stronger than the cement that holds it together. Some fellows spend more time cutting costs than it would cost them to do a perfect job.

We know a speculator who is making more money in good masonry structures than he ever made on his skinned frame shanties. Making good poor work proved more expensive than doing good work in the first place. He wanted to stay in town.

There's many bulls that we all pull, and many a slip has cost us cash, but it's the knowin' how, and the knowin' why that sure brings home the hash.

This is station J-O-E signing off till next month.

Joe, *The Mixer Boss.*

News of the Industry

With the Manufacturers

G. Massagli & Company, concrete construction contractors, announce the removal of their office and plant to 128 Parker Avenue, San Francisco, Calif.

Announcement has been made of the appointment of *Harlan A. Pratt* as manager of the Oil and Gas Engine Department of the *Ingersoll-Rand Company*. Mr. Pratt was connected for many years with the Sales Department of the Westinghouse Electric & Manufacturing Company, later becoming sales manager of the Atlantic Elevator Company, exclusive agents in the East for Westinghouse Gearless Traction Elevators. For the past three years he has been sales manager of the Elevator Supplies Company, of Hoboken, N. J.

Mr. Pratt is a graduate of Stevens Institute of Technology, and a former director of the American Institute of Electrical Engineers.

The R. E. Brooks Company, 30 Church Street, New York, N. Y., is now representing A. W. French & Co. in that city. The Ginsberg-Penn Company has been discontinued as New York representative.

Personal

Hunting, Davis and Dunnells, Incorporated, is the new name of the former Hunting-Davis Company, architects and engineers, 1150 Century Building, in Pittsburgh, Pennsylvania. Also of interest to construction men is the fact that Mr. C. G. Dunnells, professor of building construction, Carnegie Institute of Technology, has joined the firm as vice-president and chief engineer.

Batley & Kipp, Engineers, announce the removal of their offices to enlarged quarters, in Suite 2086, Illinois Merchants Bank Building, 231 South LaSalle Street, Chicago.

Dr. J. C. Morehead, Associate Professor and Curator of the Department of Architecture, will be in charge of the summer courses in architecture this year at the Carnegie Institute of Technology, according to an announcement. *Professor Camille E. Grapin*, the distinguished French architect who is a member of the regular staff at Carnegie, it is also announced, will remain for the summer session to give the courses in Outdoor Sketching and Architectural Design.

In addition to the courses to be given under the direction of *Professor Grapin*, the Department of Architecture will offer summer courses in Descriptive Geometry, Shades and Shadows, Perspective, and Trigonometry and Analytical Geometry. The courses in Architecture are scheduled for six weeks from June 14 to July 24.

Trade Associations

The *Wisconsin Mineral Aggregate Association* has announced the appointment of *Gordon F. Daggett* as Executive Secretary to succeed *Norman K. Wilson*, resigned. Mr. Daggett has had several years of experience in general engineering and highway work and is well known throughout the state. For thirteen years he has been with the Wisconsin Highway Commission in various capacities, serving as Materials Engineer for the past year and a half. He is a graduate Civil Engineer from the University of Wisconsin, a member of the American Society of Civil Engineers, a member of the Engineering Society of Wisconsin, and, with his wide acquaintance among engineers, contractors and material men, is ably qualified for this position.

The Portland Cement Association has recently appointed *R. S. Taggart* as district engineer in charge of the Pittsburgh office, Farmers Bank Building. This office has charge of the work of the Association in Western Pennsylvania. Mr. Taggart has served as field engineer in Ohio and in Western Pennsylvania since joining the Association in 1921.

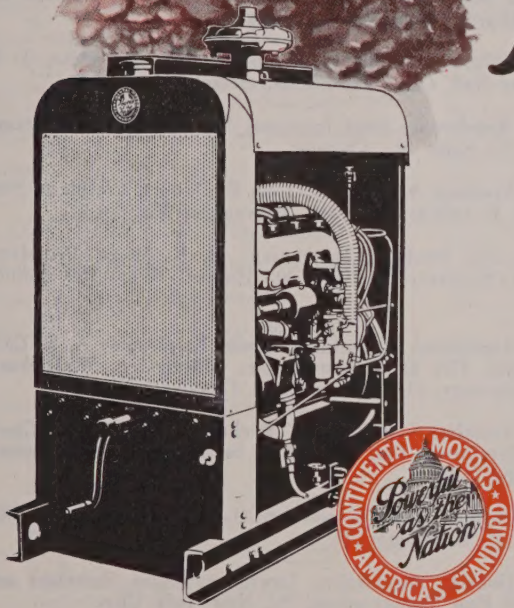


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FLEXIBLE power is particularly essential in meeting industrial needs of widely varying character.

Continental Motors give the user that flexible power which can be utilized in plant or on highway.

In addition to this flexibility Continental power is dependable and economical for daily use, with a motor backed by sound engineering, valuable experience and fine specialization.



Dependable power for
every purpose

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Offices: Detroit, Mich., U. S. A. Factories: Detroit and Muskegon
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New Books

Einflüsse Auf Beton, by Prof. Dr.-Eng. A. Kleinlogel, published by Ernst & Sohn, Berlin W. 66, Wilhelmstrasse 90, Germany.

A sort of a vademecum, an encyclopedia of all the dangers to which concrete may be subjected.

All the agencies are alphabetically arranged and their influence on concrete described by numerous examples, and the antidotes or remedies carefully noted, also generally with reports from actual performances.

The authorities are taken from the German, French and English literature with notations giving author, magazine, date and page.

The book probably represents the most complete and dependable information ever compiled on concrete structure, their maintenance and ailments—and should be of inestimable value to the concrete engineer and contractor. The author, Prof. Dr.-Eng. A. Kleinlogel, for years has impressed the students of concrete literature with his painstaking discussions and treatises—and the names of his helpers, Dr. F. Hundeshagen and Prof. Otto Graf, are seen regularly in German and Swiss engineering magazines. Our own Prof. Duff A. Abrams is frequently quoted, and the entire work is entirely up-to-date.—Dr.-Eng. E. Lee Heidenreich.

Industrial Literature

Experimental Impact Studies on Highway Bridges, a recent bulletin of the engineering experiment station of the Iowa State College, Ames, Ia., and written by Almon H. Fuller and Robert A. Caughey, is a report upon investigations of the relationship between the intensity of a blow from a truck wheel and the resultant stress in the bridge members. The work was carried on with the co-operation of the Iowa State Highway Commission and the United States Bureau of Public Roads. The relationship between speed and dynamic stress, and between speed and dynamic force (wheel blow) was found to be so nearly a straight line relationship that the straight line interpretation was generally made. The relationship between stress ration and the percentage of impact is shown by three curves. This interesting work, which was carried on with the aid of the finest scientific apparatus available, should be studied by every designer of concrete highway bridges. In writing for a copy, ask for Bulletin 75.

How to measure wire rope—how to and how not to uncoil or unreel wire rope—how to make an endless splice—how to properly seize rope—how to correctly socket wire rope—how to care for wire rope when both in and out of service, are just a few of the things told in the new 88-page handbook on wire rope recently issued by the *American Cable Company, New York*.

In addition to such information, there is shown by detailed drawings, the best methods for making equalizing slings, bridle slings, and other miscellaneous sling and fitting equipment. There also appear briefened, though complete, treatises on wire rope lubrications, the effect of heat on wire rope performance, alignment, reverse bends, fleet angle, idle ropes, and other such subjects. Seldom have we seen a book that covers in a more informative way every phase of wire rope usage, application and maintenance. Not only does it give detailed information regarding the various "lays" and the varying constructions of wire rope, but much data that should prove invaluable to wire rope users.

The Proceedings of the Second Annual Meeting, Concrete Reinforcing Steel Institute, which was in Atlantic City last March, has just been published in booklet form. These proceedings contain a list of the officers for the past year, a list of the officers for this year, minutes of the meeting, registration at the second annual meeting, the president's annual address, reports of the various committees, the new rules for bundling and tagging, the new uniform sales contract, the addresses presented by W. S. Edge, Thomas S. Holden, Emmett Hay Naylor and W. Chattin Wetherill, and the list of committees of the institute, as well as a complete list of the present members of the organization. According to the published proceedings the next meeting of the institute will be held at French Lick Springs in September.

The Industrial South is another booklet issued by the same organization describing the diversified natural resources, the products of mine, well and quarry and the products of the soil and stream. It reviews the recent construction activities of the section of the United States below the Mason-Dixon line.

Celite—an Admixture for Concrete, is explained in a bulletin recently issued by the Celite Products Company, Chicago. This is bulletin 314, giving up-to-date data on the use and benefits derived from the use of Celite—amorphous silica—as a lubricant in concrete, stucco, plaster, and mortar, and in concrete products. This diatomaceous material, when used as an admixture, is generally found to afford increased workability without necessitating the use of additional water. This, naturally, minimizes honeycombing, segregation, and loss of strength. Directions and specifications are contained in another bulletin—No. 317.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit.

American Concrete Pipe Association; M. W. Loving, Secretary, 111 West Washington St., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 West Thirty-ninth St., New York City.

American Road Builders' Association; Wm. H. Connell, President, Miss E. A. Birchland, Secretary, 29 W. 39th St., New York City. Annual meeting, New York City, May 14.

American Society for Testing Materials, C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 21-25, Atlantic City, N. J.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1038 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; 123 West Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference; Frank Burton, President, J. F. Downey, City Hall, Cambridge, Mass., Secretary.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, 160 North La Salle St., Chicago.

Concrete Products Association; John E. Powers, President, Sterling, Ill.; D. R. Collins, Secretary, Milwaukee, Wis.

Iowa Concrete Products Association; H. E. Meier, President; R. L. Gavin, Secretary-Treasurer, 405 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. E. Coleman, President, 37th St. & Stewart Ave., Chicago. A. W. Dickson, Executive Secretary, 214 Electric Bldg., Cleveland, Ohio.

National Association of Builders' Exchanges; William F. Chew, Baltimore, President; Earl F. Stokes, Secretary, 15 East Fayette St., Baltimore, Md.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East Twenty-second St., New York City.

The National Lime Association; Burton A. Ford, Secretary, 918 G. Street, N. W., Washington, D. C. Eighth annual convention, French Lick Springs, Ind., June 8-11.

National Slag Association; H. J. Love, Secretary-Treasurer, 933 Leader-News Building, Cleveland, Ohio.

National Sand and Gravel Association, V. P. Ahearn, Executive Secretary, 903 Munsey Bldg., Washington, D. C.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Wisconsin Concrete Products Association; A. P. Kuranz, Secretary-Treasurer, 425 E. Water St., Milwaukee.